The Thalassocentric Apparatus:

Connected art processes from the sea showing multi-scale changes through their own emergence and collapse

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Abstract

The sea changes in many ways and on many levels. These changes are complex and highly connected and as a result are hard to predict

Connected, changing systems of different scale are found in many areas of life. As well as physical systems such as the sea, they are apparent in emerging and collapsing ecological systems (Gunderson, Holling 2002), in systems of human ideas such as the philosophy of Deleuze and Guattari and, as I argue, in arts practice.

Although attempts to know the sea are inherently difficult, they also offer opportunities. For example, if we were better able to perceive the changes of the sea, we might better approach other pressing problems that categorise our current age, such as climate change and the threat of collapse within other socio-ecological systems. A sea-centred form of ecological thinking could promote awareness of change and connection on different scales in varied realms.

I demonstrate how forms of change, initially familiar through the movements of the sea, can be understood through arts practice. I refer to this sea-centred, ecological perception as 'thalassocentric'[i], (from the Greek *thalassa*, sea). This term denotes an outlook that (in some way) originates within the sea, even if it then addresses land, social arrangements or human imagination. Although thalassocentric understanding is derived from the movement of waves, I show that the concept can be developed as a useful tool for understanding changes beyond the oceans.

Having analysed a number of key creative practices that engage with the contexts described, I develop an arts-centred use of the term 'apparatus'. I show that art apparatuses can be considered to move and change in ways that are also thalassocentric. This model is tested and applied through a series of creative projects which suggest that changes within art apparatuses can help us understand changes elsewhere. It therefore offers a valuable model that can contribute to our knowledge and understanding of other complex systems.

Dedicated to Sal, Ivy and Lola for their loving patience
and to my parents for their support and encouragement.

Contents

Part 1

Developing the Requirements of the Thalassocentric Apparatus

Introduction

This research thesis is structured in three sections. The first, longest, written section builds a context, methodology and set of evaluative tools that will be used in sections two and three. The second section is a review of artworks by other artists. The third addresses my own, original artworks that best respond to the issues uncovered.

Adequately responding to the sea requires a range of types of knowledge. Which types of knowledge and how they will help arts practice is an important question. Using a method developed by Karen Barad I will borrow and test knowledge from different perspectives against artworks to progress the research in stages. As this research progresses, I will construct and justify a type of interdisciplinary research that uses arts practice to connect complexity theory, philosophy, hacker culture and socially distributed outdoor fieldwork and so respond to the challenges I set out. I will approach the conditions of the sea (which I describe as change and connection on different scales) as being about shape. This will allow different types of visualisation of change to be attempted.

The thesis is concerned with the sea, its connections and the ways it changes. It is also concerned with ecological changes of our time and will seek to show similarities in these types of change in a way that includes people in different ways. So the research is interested in shapes of change in non-human systems and also in human systems. The tools and processes of art (which I will describe as art apparatuses) are part of the human world (including our thoughts) and also the non-human world (including the sea and wider processes of ecological change). A discussion of how art functions as an apparatus is part of the discussion in the first stage.

So in that first part of the research, I will produce and test initial artworks against a number of critical contexts from various disciplines, to move the research forward in steps. The 'shapes' of change that the works presented will also progress and develop and become about representing change in different ways. The artworks I develop and test through the initial section of this research will establish the requirements for a thalassocentric apparatus.

These artworks include a series of drawings undertaken following sea swimming; an interactive installation looking at complex patterns of collapse in sand; and a performance that produced changing sound waves at the same time as showing the equipment it used in terms of changing waves. Each of these works will answer some questions and leave others unanswered, in a way that helps determine the next stage of enquiry. Through responding to the questions that arise in the artworks I will select and use different additional references and types of knowledge. Only after this first stage is completed, and the initial artworks are investigated and evaluated against other disciplinary knowledge, will the research have produced tools that will be used in its second and third stages.

Once this is completed, I will be in a suitable position to evaluate works of other artists against the connected changes of different types and scale, seen in the sea. The second stage does this, undertaking a review of existing relevant works using the tools developed in stage one of the thesis.

Finally, I will be able to present a series of original artworks that draw together the themes discussed. The final stage of the thesis does this by addressing the production of original artworks that respond to the initial question in the terms and context developed, to present original findings. It describes the resilience and sustainability of artworks in terms of how they are produced and disseminated. These works include devices made from discarded or cheap materials used in novel and unlikely ways. In particular, the works include underwater cameras and hydrophones and a sea kayak that can be used as a research platform. The instructions documenting the processes for making these works are shown to be an important part of the artworks too, and a final artwork documents the production of the kayak using long-lasting ceramic tiles.

I will discuss these works to show how the movements of the sea and of ecology can also be seen in the changes of thalassocentric art apparatuses. Using wave terms I will describe the emergence and collapse of materials, artworks, the spread of knowledge about how to make the artworks and the infrastructure that allows the artwork to happen. I will show movements of emergence and collapse in the thalassocentric apparatus as relevant to the movement of the sea and to the changes in ecology. This is proposed as the contribution to knowledge of this thesis.

Chapter 1 Articulating the Problem of the Sea

I shall start by describing some of the context of the sea and looking at the implications for different ways of understanding it. I will initially state three conditions (change, scale and connection) that help us to recognise what I here term the problem of the sea. The first half of this chapter will demonstrate that these conditions cannot be considered separately. Since one of these conditions is that of *connection*, I will show that they must repeatedly be turned back on each other to be considered together. I will initially look at waves as central to an understanding of these conditions and I will immediately start to think of waves as more than just salt water. I will move from the idea of waves in water to other forms of oscillation; emergence and collapse in substrates other than water.

A way of looking that understands multiple types of movement and change would be a powerful tool for looking at the changes of the sea. Processes with these sorts of conditions can be defined as complex. While there is not agreed definition of what a complex system is[ii], the term is used to variously describe systems with multiple agents acting together, leading to unpredictable or emergent behaviour. This ultimately means complexity is a term used to describe types of pattern (Ladyman et al, 2013). It is a term applied to conditions such as evolution, ecology, economies and the human mind (Lewin, 1999; Waldrop, 1992). I address complex systems more closely in chapter 4. But in this chapter I describe how the movements and changes of the sea show forms of complexity. And I will start to look at how arts practices have been able to think in terms that are appropriate to the rich connectedness of the sea and its different sorts of intensities.

I will show that, due to the connections of and around the sea, it is hard to draw a definitive boundary around the sea. Its influence keeps spreading and escaping and

so requires many forms of knowledge to be described adequately. However, I start with an initial, partial, look at the sea, as understood by oceanographers, and historians and then artists. This chapter will also introduce a number of ideas dealt with in greater depth at later stages of the first section of this thesis.

Thalassocentric Perspective

To define the conditions of the sea that we need to recognise and engage with, I must describe exactly what 'thalassocentric conditions' are.

I start by looking at the matter from which the sea is composed. This may seem a facile embarkation point - most obviously it is salt water - but much of the significance and agency of the sea comes not from this material identity, but rather from the behaviours of this material; how it moves in time; how it performs. So I am considering the behaviour of the sea's material. Looking at the waves occurring *through* the sea will help to start to respond to the problem of the sea.

In physical terms waves are not exactly, nor completely the movement of water. You have to look beyond the water. Waves travel from one location of high energy (for instance an area of atmospheric pressure) to an area of low energy, but the water itself circulates more locally than the passing wave (Holthuijsen, 2010). The water does not move laterally, following the course of the wave. This local rolling of water drives movement of adjacent water and so a wave propagates. When a wave covers distance, it is not the material itself, but the behaviour of that material that travels that distance.

Change, Scale and Connection are Problems of *Intensity*

Manuel De Landa *(2004)* uses the term *intensities* when talking about complex material change (which he interprets in the context of the work of Gilles Deleuze, who I turn to in chapter 6). De Landa differentiates between systems that can be measured and touched – extensive systems – and those that cannot, which he calls intensive. If we view the movement of waves as separate from the movement of water, we can think of waves as a movement, or communication of 'intensity'. They are an energetic signal that travels through the extensive salt water medium (or other substrates). Seeing waves in these terms, rather than just seeing the water, shifts our gaze onto another level and into what we might consider a different

conceptual space. We can start to look at the movement *of* the movement, ie the connections between the changes. This research will focus predominantly on intensive change and connection at many scales. But this is not to isolate intensive movements from extensive movements. One is derived from the other. Intensive forces will be shown to emerge from extensive properties. The intensive movements of waves are derived from material changes in saltwater.

Addressing intensities and their transmission will make more sense of systems that would otherwise appear unconnected. It will be a helpful lens through which to view the changes of the sea. It will also encourage a more general move away from thinking about static isolated events. So I am looking at the problem of the sea by largely considering the *intensive* behaviours of the sea, even though these behaviours arise from extensive materials. I will attempt to ask how arts practice shows this. But first I will look more closely at the conditions giving rise to the problem of the sea.

Change, Scale and Connection: *Change*

The first problem of the sea is that it is constantly changing. It changes in shape. Anything in the sea is moved, battered, colonised or changed in other ways. These changes are, and always have been, conditions of the sea, but they are also relevant in more contemporary ways. In our age of ecological crisis, we are also becoming more aware of changes that occur *to* the sea; for instance changes in its temperature, salinity, acidity, levels of pollution and the patterns of movement of currents and layers of water that move through it. To look at the sea and its conditions is an ecological activity.

The sea *is* change. It changes on a moment by moment basis. It changes half-daily and with the lunar month. It changes seasonally and these changes have a pattern themselves, an oscillation that sits across smaller oscillations. Some of these apparently stable, long-term patterns are themselves changing (on large scales, not easily observed within our daily routines) as an effect of climate change. The sea is changing in salinity, in acidity, in carbon dioxide levels and in the levels and distribution of animal and plant species (IPCC 2014)[iii]. But the sea has always been in change; it is the definitive site of fluidity, yet the changes it is undergoing most recently have implications for the activities of humankind and our socio-economic

projects on the largest scales. The industries it supports are part of that change too. This starts to show us how change in the sea occurs on many scales and how it connects many activities.

The problem of the sea is in many ways analogous to the problems of what has been termed the anthropocene. This term was publicised to describe a new geological period, defined by human impacts (Crutzen, 2002). It describes many human-induced effects that will have a planetary-scale impact (including for instance, climate change, species extinction, ocean acidification and pollution).

In the context of the anthropocene, Steffen et al (2015) list nine planetary boundaries categorising aspects of atmosphere, fresh and oceanic water, land use, biosystems and pollutants. Bypassing these boundaries risks driving the Earth System into a new state. The authors state that four of the nine planetary boundaries have been crossed, including what they term the 'core boundaries' of climate change and biosphere integrity. And these planetary boundaries interact in many ways with each other and with human activities. The anthropocene is a set of conditions of connected change that include the sea and include people. They are highly connected and exhibit emergent behaviours and unexpected shifts in condition.

However, the anthropocene is a concept with limitations. Since it derives from geology, it draws attention to changes of very large and slow scale. This is helpful because much environmental change is not immediately observable on the scale of human experience. But it does neglect effects and perceptions at lesser scales than the geological. It ignores subjective experience, it ignores collective beliefs, the scale of social and cultural experience, and it ignores political forces and activities unless they are aggregated into global impacts. Given the origin of the ecological crises the term seeks to address, and the geo-political realities of how those crises are experienced, this is a notable limitation. In an attempt to address the more-than-human adequately, it leaves behind some of the immediately-human that is so very relevant.

There is a tension evident in this attempt to appropriately place humanity within events of global scale; a paradox at the heart of the name. *Anthropocene* as a term

attempts to support technical discussion about the non-human but reasserts the human (a*nthropo*- meaning human in Greek (Oxford Dictionary of English)) right in the centre of the earth's story. The coining of such a name might be interpreted as the ultimate act of anthropocentrism and hubris. However, the *type* of human acts and impacts that it describes are not intentional ones. The signal phenomena of the anthropocene are not planned ones. They are the result of our mistakes and oversights, of processes that we have neglected or put in train without understanding. The *anthropo* that marks the geological record is not the rational, humanism of science, enterprise and the mastery of a separate environment. It is the entangled *anthropo* of leaky risks and forces that include the non-human. The Anthropocene is named after our oversights. Notwithstanding this limitation, the term's acknowledgement of impacts at scales beyond immediate, every-day existence is a useful initial framing of the issues that emphasise wider, non-human process. But my use of this phrase must move to include human experience of other scales, including subjective and social realities. And later in the thesis I progress the context in that direction, using Guattari's theory of three ecologies.

The idea of the anthropocene has been examined from many perspectives, including those of creativity. Gibson, Bird Rose and Fincher (2015), call for 'new ways of thinking and knowing, and innovative forms of action' in response. (Gibson et al, 2015: i). They describe the end of 10 millennia of climatic stability (which allowed the emergence of agricultural, social and technical revolutions), to be increasingly replaced by instability and types of collapse (ibid:23). The idea of the anthropocene is very relevant to contextualise this research. The sea is subject to changes that are taking place across the entire planet and on larger time scales. The anthropocene is a term that describes a very complex system of connected change occurring on many levels and exhibiting emergent and unpredictable problems. It shares characteristics with the sea and learning to think in ways that understand the characteristics of the sea may help understand the connected change of the anthropocene.

Change, Scale and Connection: Scale

So secondly, these changes take place over a range of scales, from the tiny ripples in water, to the growth and decline of species and industries. There are changes of a few millimetres in size, and those that cross oceans and continents. There are

changes that are quick and those that take many human lifetimes. These are changes at different scales of space, and scales of time, across an interconnected system with the sea at its heart.

The largest sea waves are vanishingly slow, determined by continent formation and the orbit of heavenly bodies (oscillations within the sea are connected with very distant forces and events). The longest waves are generated by fluctuations in the Earth's crust and atmosphere. Tides, generated by interaction of seas, Moon and Sun take place over hours and have a wavelength of hundreds, to thousands, of kilometres (Holthuijsen, 2010: 3-5). The sloshing undulations of vast bodies of water cause changes in the seabed and coastal folds with which they interact.

The forms of the waves themselves are configured by the depth of the water and shape of the seabed, the interplay of currents and rebounding backwash resonating off landmass or sea walls. Ripples (which oceanographers refer to as *capillary waves)* (ibid: 3-5) ride on and confuse the pattern of these waves, as they are pulled and thrown by the movement of moon and sun, washing planetary volumes of water around a bumpy and irregular surface. Storm surges caused by low pressure of storms (patterns of rising and falling atmospheric pressure) take place over a few hundred kilometres and a few days. Other intensive oscillations include unpredictable *seiches;* standing waves which develop within partially bounded 'resonant basins' (such as a harbour, or bay). The features of the basin surface bubble up and wear away over geological time, becoming ground down, dug into ridges or silted up over non-human time scales. More noticeable on a human scale are waves generated by wind, and the water's own earthly gravity. These include *surface gravity waves*, *wind sea* and *swell* between ¼ and 30 seconds in periodicity. Groups of these waves generate *surf beat* over a few minutes (ibid: 3-5).

These ripples and waves of many scales sit on top of, or within, each other. The multiple scales of waveform coexist and interact to make connected, semi-irregular patterns. Structure emerges and passes. Waves combine and subtract from each other to make peaks or troughs which are complex across many scales. The range of scales on which the sea acts is wider than we can consider at any one time. While it is useful for engineers to extract or isolate a distinct frequency of oscillation from this cacophony, in 'the field'[iv] the behaviour of the sea is richer and more

noisome. I will introduce an engineer's description of marine behaviour to look at these shapes further in chapter 2.

Viewed over time, these events have their own patterns of change. If extreme weather has been increasing recently due to global warming, then the *frequency* of storms and floods is increasing – a new order of change emerges across the whole meteorological system.

This overlapping of scales has a special name; imbricate, a concept which is used by systems ecologists to model the feedback within complex systems. Westley et al (2002: 107), describe how 'An imbricate series of mechanisms, [is] partly distinctive yet partially overlapping in return time and function'. They continue to explore how the behaviour of such systems determines that system's stability, or more exactly, its resilience. Looking at a system's resilience is a way of asking if that system could continue in similar patterns of behaviour following shocks or changes to it. Will the emerging patterns within waves grow, persist or fade?

An interest in the resilience of connected changing systems is a practical interest in the face of the anthropocene. Will the patterns in natures and cultures emerge, persist or fade? Such questions might be answered through an understanding of complex movements such as those that take place in and around the sea[v]. The ecological relevance of these questions sharpens our interest in connected, multi-scale change and I will look more closely at theories that describe collapse and emergence in chapter 4.

Change, scale and connection: *Connection*

As is becoming clear then, the third consideration is that the multi-scale changes observable in the sea are connected with other systems. Currents, populations of marine animals and meteorological conditions affect each other as part of a complex web of interaction. These 'natural' systems are also connected in subtle or not-so-subtle ways with industry, politics and culture. Nature and man are not so easily separated (Latour: 1993, 2009), but must be considered together. This connection has implications for how we approach the ecological or environmental issues around the sea. We cannot think that change is caused just by man then felt by nature, nor vice versa. The changes in the sea are felt by humans, but are also prompted by

human activity (Harley et al, 2006; IPCC, 2014). Change works both (indeed many) ways and the connections of cause and effect straddle areas of life that are often dealt with by separated areas of study. So this research must avoid being too atomised in perspective, not too focussed on a single scale. This will force a careful process of assembling and testing of disciplinary perspectives to support an interdisciplinary outlook for the arts practice at the heart of this research.

For now I will consider some of the numerous ways the sea is 'connected'. The sea connects things despite our attempts to draw a line around it, as if to contain it. It escapes its bounds. Changes that move through the sea also travel through different substrates. And as well as physical movement and change, the sea connects *events* and conditions far beyond its boundaries, such as changes in human lives and societies. How far does the sea extend then?

Clearly, from the perspective of culture and history, a sea's bounds extend further than a coastline. Its influence extends through lines of trade, human contact and global trade routes. Writing of the extent of the Mediterranean, the historian Braudel says 'We might compare it to an electric or magnetic field' (Braudel: 2002, 168). For him the Mediterranean extends into the peninsulas of Europe, and culture of the middle east and throughout the Sahara, carried on technologies of sailing, monetary systems, and historical and cultural trade routes. Cultural history shows that we must connect the sea with other distant locations and displaced effects, through cultures, technologies and materials.

It is not difficult to see the arbitrary nature of boundaries we apply to the sea. The coastline is an approximation of a real boundary; a line that cannot be measured definitively. The more closely you look at the coastline, the more detail you find it has. Bays include inlets, which include crevices. Rocks have cracks. Sand has dimples. The more accurately you attempt to measure the full length of the coastline, the longer this line of measurement has to become (Lewin 1999), due to endless wiggles on wiggles, over many scales. A thalassocentric perspective must look further into other types of geometry to follow its connections and continuations. In chapter 4 I will discuss the idea of fractal geometry to describe the connected changes that occur on different scales. Again we are reminded that multiple scales and orders are inescapable considerations when engaging with the sea.

Even if it were possible to agree that the sea is bounded by a line of fixed length, then it must be acknowledged that with the tides and weather this line moves up and down (or in and out, depending whether you are looking at it from in the sea, or from above occupying the conceptual space of a map viewer). I will increasingly show that the conceptual space a form of knowledge sits in, as it looks on and examines the sea, has to be taken into consideration as making a difference to the thing it looks at. How to manage this will be resolved in chapter 6.

And instead of being able to draw a fixed line around the sea (of whatever length), we have a zone of possibility – the littoral zone – at the interface between marine and terrestrial. This must be viewed as a shifting bracket of probability over time. Less-likely events can still occur where the sea moves outside this bracket of probability. The littoral zone is exceeded by extreme storms and floods (which become times of crisis for us – an intensive ebb in human fortunes connected with change in the extensive sea). A littoral zone is a middle 'ground' where the sea *might* end. The problem of the sea reinforces conditions of societal risk we are all facing (Beck, 1992). A powerful way to manage the uncertainty of the complex, changing sea is through discussion of the likely and the unlikely. I will show how arts practices manage this later in this chapter.

Our starting example of wave movement, introduced here, was transmitted through seawater. But it neither starts nor ends there. It connects conditions that occur outside of the apparent boundary of the sea. This example originated in air (in patterns of high pressure), before travelling through salt water. When it arrives at a coastline a wave will cause water to crash onto land (be it rock, beach, or coastal town). The wave does not disappear as it crosses from saltwater to other substrates. The sound of the crashing waves is also a waveform; transmitted again in air. The movement of sediment in the coastal waters and the re-arrangement and sifting of shingle on the beach is a function of the waveform. Multiple waves temporarily 'write' their presence and passage in coastlines over larger orders of time and across transitions between different materials.

Waves of sea become waves of land also. Sand and rock is sifted. Rock and soil is eroded (gone from a terrestrial perspective, but from a thalassocentric perspective,

transported, re-mobilised or sedimented, perhaps to be folded into new ripples over geological time). Bays are carved, sea defences eroded. A thalassocentric perspective requires an awareness of causal connections that are not constrained by boundaries that limit other perspectives.

Cartographic boundaries now appear indeterminate (we can't assume the sea *starts* at this mark, *stops* at this one...). The seas cross boundaries in many ways. When the sea oscillates, populations and conditions (human and non-human) oscillate too. It is necessary to consider different forms of connected change besides physical movement.

A Summary of the Problem of the Sea

This section has described the interconnected conditions of the sea and shown how they cannot be taken in consideration singly, ignoring the fact of their interconnections. The economy, ecology and culture of and around the sea are all interconnected and show conditions of complexity. They can be studied singularly, but this would require ignoring those connections. All of these conditions change in themselves and bring about change (often in unpredictable ways) in each other.

Meanwhile, the material changes of the sea might appear easier to understand; we can see the movements of waves and easily conceive of similar movements of different scale (ripple, or tidal oscillation) even if we can't see them at the same time. But the more we look even at these physical movements of the sea, the more we see that their shapes are also elusive, in that the movements of the sea are hard to bound and they are connected with other material systems. Indeed the apparently separate systems of moving water and other systems (such as human conditions around the sea), are connected. Material changes lead to changes in systems of different scale or order; systems that are intensive, to use the word of Manuel De Landa.

Recognising and representing these connected forms of movement is a challenge for any discipline. If it is manageable, such a representation would help present conditions that are very relevant to the anthropocene. And yet, such a type (or such types) of movement would have to draw on many types of knowledge, from a range of disciplines.

The methodological question has been clarified, but not answered. How can arts practice make use of different disciplines that describe the movements seen in the sea? And which disciplines would those be?

Questions, Methodology and Disciplines

Now a context is described, I must state a methodology that will be able to respond to that context and explain how it will relate to arts practice in such a way that knowledge will be developed to progress this research.

This is, in part, a disciplinary question; one about how arts practice that aspires to address thalassocentric conditions *aligns* with other disciplines. Which other disciplines are relevant and how can their different forms and methods of knowledge relate? I will ask whether the knowledge produced outside of arts practice can be reflected by art, or vice versa. However, arts practice is not often chosen as a way of producing knowledge about the sea in the context of ecological issues, for instance when addressing climate change.

Art often excluded

Critics specialising in art and climate change note that for artists interested in critical responses to ecological crisis wrought through unsustainability, there is 'confusion about how to 'place' [their] work and about how it relates to science, policy, and the creative arts' (Butler et al (eds), 2011: 7). Despite a growth in art that addresses ecological change, cultural practices such as the arts are not often included by other disciplines in research that seeks to understand the environmental changes of our age (Hulme: 2011).

But, I will show that the apparent difficulties of perception presented by complex changes may not be as difficult for the arts as other ways of knowing. A thalassocentric approach which combines arts practices with other disciplinary insights could start to offer valuable insights into the problem of the sea, and also into other ecological contexts of connection, change and multiple scale.

If we look to existing cross-cultural initiatives addressing ecological change (eg. Culture and Climate Change: Recordings (Butler et al (eds), 2011) the unexpected nature of the conditions we face becomes clear. We are required to think with

greater fluidity about what we take for granted. To play with possibility, 'constructing the unforeseen' as a form of 'structured improvisation' (Tyszczuk, 2011: 27).

These conditions are outlandish[vi] perhaps. Understanding outlands (space and conditions beyond areas of predictable solidity) becomes a contemporary challenge given multiple ecological changes. It is also very familiar to those spending time in and around the sea. And it is a creative and cultural behaviour.

Art practices have to adopt a position in relation to the knowledge they produce. Should it be based on the observation of non-human objects (relating closely to sciences of one form or another), or should it address conditions in human histories and imaginations of possibility? And is it possible (or necessary) to reconfigure and play with these positions?[vii]

So responding to and engaging with thalassocentric conditions requires practices that can address unforeseen changes and our role and response to them. It will also require the assembling or 'placing' of creative practice within a field of references and ways of knowing that suit the problem of the sea I have described.

Considering Disciplines

Before I can show the appropriateness of the research methodology that I will adopt to progress this research, I will show how the problems of disciplinary configuration underpinning the issue at hand are about two types of knowledge; knowledge about humans and knowledge about things that are non-human. In order to explain this division in types of knowledge, I will interpret artworks that do address the sea, with the help of the work of Bruno Latour. This will explain how knowledge-making practices can easily divide themselves into human concerns or non-human concerns. To successfully respond to 'the problem of the sea' (as I have categorised it), will require a form of knowledge (ie a type of disciplinary arrangement) that can say something about both human *and* non-human conditions. Latour (1993, 2009) uses the ideas of subjective knowledge (about the individual who does the *knowing*), and objective knowledge (about the thing *that is known*) when addressing these issues. This helps to show how these two types of knowledge apply to ecological contexts such as those of the sea. This short comparison of artworks, using the work of Latour, will also prepare the way for an understanding of Karen

Barad's method that I will apply to my methodology.

Latour and separated ways of knowing

The two issues of aligning disciplines around an arts practice and developing a form of expanded ecology are in some ways the same question. They both ask about how we constitute forms of knowledge in ways that include what we refer to as 'nature'.

The work of Bruno Latour helps to address both these questions. He shows how the way that ideas of nature are constituted determines what different disciplinary practices (such as science or cultural discourse) are assumed to be capable of.

Science plays a key role in Latour's critique of *bicameralism* (meaning literally two rooms, as in two houses of a parliament, one of nature, the other of politics) (Latour, 2009: 115). Within this unhelpfully divided system of thought, Latour shows that nature is only made to 'talk' when interpreted by the special class of scientists, who are able to claim access to objective truth by virtue of their apparatuses. These apparatuses are then able to translate the effects of nature into credible, impartial signs and traces to be read by humans. The result of this separation into two types (or houses) of knowledge is that 'on the one hand we have the chattering of fictions; on the other, the silence of reality' (Latour, 2009: 15).

A separation in thinking (or cut[viii]), between the individual subjective mind and external materiality is produced that also leads to a division at a collective level between nature and culture. On one side nature is the external realm of materiality which can be viewed mechanistically, to be understood and controlled by the rational mind. On the other, culture is the realm in which people develop, share and argue for subjectivities, separate from non-thinking phenomena (Latour, 1993: 10-11, 37).

According to Latour's description of bicameralism, philosophers and (later) scientists had to reject subjective methods and perspectives if they were to understand or make claims about truth. To taint knowledge-making with subjectivity was to give in to confusions and arguments that are small and distracting (Latour, 2009: 10). A group of disciplines, and with them methodologies and associated tools and political arrangements were developed to access 'truths' ...and ultimately “laws not made by human hands” (ibid:10).

Given this, the problem of aligning arts practice in the context of a non-human, changing, ecological sea becomes clearer, but no less difficult. The disciplines that produce the different forms of knowledge for the two houses cannot be mixed. There is 'no possible continuity between the world of human beings and access to truths "not made by human hands"' (Latour, 2009:18). Within this bicameral perspective, credible objective knowledge about a separate nature must be untainted by subjectivity, by political pressure, or other human arguments and uncertainties. It is the preserve of objective knowledge practices such as science.

The other 'camera' or house of knowledge, is cultural, political and subjective. And just as the role of science is separated and kept pure in the bicameralism that Latour describes, then so are cultural practices. In these terms art is only able to talk about cultural, political or even strictly personal things. It is unable to speak about the non-human world with credibility. Again, for reasons that we are beginning to see, ecological crisis may represent a 'crisis of objectivity' (Latour, 2009:18).

This separation has implications in many ways. It has defined a technologically-produced modernity that is perceived in opposition to the beings and conditions of 'nature'. It has implications for how we view our knowledge of the non-human world, and how we expect that world to act. It has influenced our cultural attitudes towards non-western people, their use of technologies and our ideas of progress and the idea of being close to nature (Latour, 1993: 91). Latour develops an anthropological outlook that has implications for how our place in history is viewed. So our bicameral constitution also influences our attitudes towards temporality, progress and at some level historicism.

To address or attempt to reformulate the ecological relations between people and nature has the potential to affect these perceptions in many ways. Climate change is about materials, such as the atmosphere, but it is caused by conditions and forces that are subjective, or produced by the individual and collective subjective outlooks of the human mind. Again, the ecological conditions of the sea are shown to connect non-human materials and ways of thinking. A break down and recombination of these relations is needed in some way (or a recognition that this has always been the case).

Looking at examples of artwork in light of this division of perception will show difficulties and opportunities for arts practices engaged with ecological change. How can art show the attachments and entanglements between these two cameras, and by what means? Answering this will lead on to a description of an appropriate methodology for the process of research.

Art Examples

The film work *Hydra Decapita* (Otolith Group: 2010) reinterprets an Atlantic history in ways that could be said to be outlandish, if that were not too flippant a word for the tragedies they recount. During the transatlantic slave trade, pregnant slaves were thrown overboard during passage (discarded as uneconomical). The film speculates on the marine-centred species of near-humans that might have evolved from these lost children. This is an ocean that bears waves of migration and slavery on multiple currents. Thalassocentric *intensities* cross bounds into other fields and other realms, both factual and speculative. This cultural practice has the resources to connect the emotional tragedies of a personal scale with Atlantic movements in race, culture, biology and economics. We do not learn anything of the sea in itself, but we do read many layers of human history within it. A careful assembly of disciplinary contexts develops an interdisciplinary practice that is able to retain imagination, but address complex conditions, showing us a possible model of outlandish relations between practices and types of knowledge. This work draws together history, economy, cultural identity and deep movements of emotion and empathy.

Other arts practices align different disciplinary concerns to show connection and change on different scales and in more material ways. Peaks and troughs in fish stocks can bring about waves of change in conditions on land, and in human societies and cultures. The film *Darwin's Nightmare* (Sauper: 2004) shows how the fish stocks of an inland 'sea' – Lake Victoria – are driven by global politics, and how they in their turn animate social and economic intensities (including poverty, prostitution and weapon smuggling) as well as changes within the immediate ecology of that body of water. Sauper manages to connect non-human conditions with human conditions on a societal level. The work uses documentary disciplinary practice and presents factual, objective information. It leaves the viewer in despair

as it puts together a strong argument, or reading, of existing conditions and what has brought them about.

The practices of Sauper and Otolith Group perceive crisis and describe current and historic conditions in tragic terms. But *Hydra Decapita* also moves into a different register of possibility; a field of altered potential that might exist in a different time. The disciplinary alignments of art makes use of speculative and concrete resources in varied proportions. They are able to address politics, history and environment using evidence from other disciplines and with altered and extreme states of possibility and different ways of combining knowledge. *Hydra Decapita* shows an important lesson in terms of the disciplinary mix that might address ecologies undergoing change. It includes unlikely and (what I have termed) outlandish possibility in a way that opens up future possibility. While addressing tragedy, its result is not as closed as that of *Darwin's Nightmare*. The powerful imaginative resources of subjective artistic practices are shown as very relevant in Otolith Group's work. Facing uncertain futures requires this subjective, artistic resource. But it also needs an understanding of material conditions. Otolith Group's work did address material historic conditions, but not those of contemporary environment, economy and society. A third comparison helps here.

Other art examples can be found that deal with environment or ecological change in ways that continue the same division. Data from scientific methods can be visualised by artworks[ix]. For example United Visual Artists present scientifically-authored data alongside other disciplinary reflections in a range of forms, using an immersive installation to engage an audience (*High Arctic, An Expedition Experience*, 2011-2012, National Maritime Museum). The work is described on the artists' website:

> 'Using a UV torch to interact with animations, visitors will discover 3000 glaciers that will have melted by the end of this century and be confronted with human impact to this environment over the course of history.' (United Visual Artists)

A powerful narrative of realisation is presented, showing credible material knowledge that is not sufficiently recognised by non-scientists. The work bridges distinct forms of knowledge with the artists and general public on one side and scientific knowledge on the other. What was once a stream of numbers becomes an

experience that uses art materials and art contexts to make its point. But the point remains the same. Although presented as interdisciplinary, such a combination of disciplinary roles allows those disciplines to remain largely separate, even if they are co-present within the same work. Arts practice is presenting, to a presumably non-expert audience, knowledge which otherwise is restricted to the privileged expert (who does not need the subjectifying interpretation). Neither discipline changes, though both play a role in the work. This work shows science using art as a form of communication. Arts knowledge does not change what is known.

These examples illustrate different positions in the balance and relationship between practices that describe subjectively-derived forms of knowledge and those practices that claim knowledge of objects and 'objective' conditions. They are rich and engaging. They deal with environment, the sea, society, history, economics, trade, possibilities and alternatives as well as existing traditions in art. They manage to do many things but the separation of *cameras* described by Latour is hard to escape. Where different types of knowledge meet it is through a combination of disciplines. If I am to combine and address the problem of the sea, I must have a way of combining disciplines and testing them that is suitable for working beyond the cameras of Latour's critique.

This research is undertaken in the context initiated by my own visual arts practice. It progresses from that position to review and consider a range of possible arts practices that are relevant to the issues I have set out. It also seeks to describe work that moves beyond relevant limitations of some visual arts practice. For instance, the gallery system supporting production of art objects and its reliance on commercial investments of high-net-worth individuals is strongly connected to the economic system of unsustainability that has led to conditions of the anthropocene. And scientific and technical knowledge, social relations and the role of individual subjectivities are relevant fields of knowledge to be engaged with by this research. So in later stages of the research I will consider practices that offer different perspectives to the problems of thalassocentric conditions. I will consider studio-based, public realm and cross-disciplinary practices and performances and acts of reconfiguration undertaken outside of gallery and studio-based arts practices. Examples will be included that involve social arrangements, film-based performances and the reconfiguration and reclassification of materials (reconfigured

by artists, curators and non-humans), as well as research and field trips, and practices that use arts methods alongside scientific ones. Works will also address different aspects of sustainability, looking at their own resource use, individual's access to industrial processes and the social significance of collaboration and open distribution.

I have described the problem of the sea and the separation of knowledge that hinders a meaningful understanding of it in the ecological terms of the anthropocene. Examples of arts practice show how it is possible to mix disciplinary knowledge. But relating material change (which Sauper, or UVA have shown) to an understanding of subtle subjective insights and change (as shown by Otolith Group) is hard. And where this is touched on in the works above, there is still a need for a more systematic way of evaluating it.

To undertake this process of relating types of knowledge I will use Karen Barad's method of diffractive reading, which I explain next. Once explained, I will apply this method in the following chapters to a range of artistic works of my own and to different disciplinary contexts. Through this I will describe the criteria necessary for artworks to engage with the conditions I have set out. This will also offer critical tools to review works by other artists. It will help position my own arts practice and the research it drives within a wider field, and it will support the production and understanding of that work and its outcomes.

Reflecting or Diffracting?

While attempting to assemble and relate the different forms of knowledge and ways of knowing I must ask how these practices relate. How do 'objective' practices inform arts practice and how does art inform them? Is it possible to 'reflect' on art using other forms of knowledge? Is this a meaningful and appropriate relationship between different forms of knowledge given our shifting, connected, ecological ambitions? Is reflection a meaningful method or word for that matter?

Barad develops her approach via Dona Haraway and Trinh Minh-ha, whose metaphorical uses of the geometry of light – diffraction in particular – consider new relations of difference; for instance the difference between types of knowledge. Minh-ha provides alternative ways of thinking to reflection, which Haraway rejects as

inviting 'The illusion of essential, fixed position' while diffraction 'trains us to more subtle vision'. Reflection is suggested as being a 'Sterile replication of otherness, hierarchical domination, incorporation of parts into wholes...symbiotic fusion, antagonistic opposition, and instrumental production from resource' (Haraway, 1992: 295-337).

Is it necessary to allow both viewer and viewed to change within this research? In order to move to different relations between the apparently separate cameras of knowledge this does appear necessary.

Barad's Method

Karen Barad (2007), addresses the relationship between the different types of knowledge discussed above. She uses the term 'entanglements' to describe connections between human discourse and non-human materials. This word is borrowed from particle physics. She makes the point that entanglements are accepted at a quantum level, and they can affect both the observer and the observed. However, she emphasises that this scale is not a special case. These forces apply - less visibly - at the greatest of scales also. For her, entanglements raise questions that are about how we know, what we know and the significance of our knowledge. She calls this 'ethico-episto-ontology' (Barad, 2007: 26).

How does this apply to disciplines? A form of enquiry using a 'subject' field of knowing, to address an 'object' field of enquiry assumes a stable and unchanging platform of observation (what Karen Barad refers to as a 'fixed referent' (Barad, 2007: 26). Ie when you have learnt, the tools used to learn are the same as before. However, the research I undertake here must acknowledge that both observer and observed change during the process of knowledge production. This is part of the thalassocentric perspective of connected movement. It is also a key part of Barad's method and the heart of Haraway and Minh-ha's rejection of reflection. Instead of reflecting, the 'mirror' must change too.

These are very relevant objections when attempting a thalassocentric perspective. Instead of reflection Haraway advocates diffraction. 'Diffraction is a mapping of interference, not of replication, reflection, or reproduction. A diffraction pattern does not map where differences appear, but rather maps where the effects of difference

appear' (Haraway, 1999: unpaginated). Diffraction can be seen as a term that describes the interference of multiple waves.

So a ‘diffractive methodology’, developed from a new understanding of the nature of scientific practice, also applies more broadly to *how we come to know things*, the character of *what it is we know* and the *implications of this knowledge* for how we live. There is 'a fundamental inseperability of epistemological, ontological and ethical considerations.' (Barad, 2007: 26)

My Methdology

Following this method and incorporating it into my own methodology, I propose to develop and move between the diffractions of differing forms of knowledge. Each instance of engagement with a form of knowledge can change the knowledge that looks at it. Art can change (and so expand) understandings of ecology. Ecology can change how art is perceived.

I will do this by producing and testing the artworks I have already described. The sea swimming drawings I address in the next chapter will be diffracted against the problem of the sea and Barad's idea of entanglement that has already been described, and so will change how that problem is understood at the same time as the drawings are understood. Then the artwork that uses sand will be diffracted against different ideas of complex systems that exhibit their own organisation, or agency. An artwork that uses and shows sound waves alongside waves of change in technological infrastructures will also follow this method.

So, the final chapter of the first section will assemble and relate these ideas and findings using the work of Deleuze and Guattari. The result will be a description of changing intensive space that occurs across the different realms of subjectivity, the non-human world and social collectives. I will show how this intensive change has the characteristics that have been described through the process of arts-led diffraction. It involves and communicates emergence and collapse. It is complex and takes place on many levels and scales. And it is a space in which the process of knowing is totally immersed and constantly part of what it looks at.

These arrangements and structures of change, described and assembled in ways

that have particular relevance for a perception that is based in the sea, will then be applied to artworks. The choice of artworks is also helped by the process of drawing together the findings at the end of the first section. Works will be selected under headings taken from the three realms of change described by Deleuze and within Guattari's three ecologies.

Then the findings from the first two sections will support the production and interpretation of the final artworks that respond to the initial question that has now been modified and developed through the process of research. It is appropriate to look at Barad's method that is used in this first section now.

Using diffraction

Barad (2007) develops her critical method based upon the entanglement between natural phenomena and the devices that sense them. A diffractive method denotes a process where object and subject affect each other; for instance in a disciplinary procedure, looking at an issue changes the practice (akin to the process described by Pickering (1995) as the mangle of practice). Within scientific experimentation it is tools that are changed by how they are used. Within critical studies, discourse and material conditions influence and entangle each other. And this description of method is a valuable attempt to describe a procedure that I am undertaking within this practice-based research project. It is also clearly relevant in a connected, ever-changing marine context.

Barad's reason for introducing physics into argumentation is not that it produces definitive knowledge against which cultural discourse can be adjusted. Quite the opposite (ibid: 74). Instead she demonstrates that ethical and philosophical knowledge can be used to build meaningful understanding within physics and that the insights of physics (or other disciplines) may influence cultural theory. Disciplines are not accepted as definitive, but are open to diffractive reading, one against the other.

Barad uses this methodology to move away from what Latour calls bicameralism. She argues that both natural and cultural realities (or the ‘material and the discursive’) play a role in knowledge production. It is not sufficient to merely describe the natural (using tried and tested, unchanging descriptive references) to

arrive at credible knowledge according to this critique. Just as *nature* continues to change, so must our knowledge and ways of knowing. In particular she rejects the notion of an unchanging point of certainty against which other changes can be measured (Barad, 2007: 88).

Barad applies diffraction to mean an iterative method of considering a phenomenon, then 'tuning' the apparatus used to observe (and also produce) that phenomenon to ask further of our understanding of it. Diffractive methodology also recognises that the tool used to undertake an investigation changes and it has the potential to become, at another point, the object of inquiry (ibid, 87-88).

Attachments and entanglements form along the tools (or as I will call them, apparatuses) which are used to make knowledge. In some ways, the entanglements *are* the apparatuses. I will go on to talk about the tools or apparatuses I use, which will offer a focus for this research. They will become the centre around which I will attempt an expanded ecology as introduced above (since apparatuses are critical to the practices and disciplines involved). Novel types of apparatus might also lead to different constitutions of knowledge other than the bicameralism Latour critiques. I deal with different types of apparatus in depth in following chapters and go on to develop art apparatuses that may be suitable for developing thalassocentric perspectives; what might be termed thalassocentric apparatuses.

Summary

The sea is complex in its movements and changes because they combine and connect with many things which take place over many scales of organisation. I have shown how arts practices can consider multiple possible realities and potentialities of the sea. They can access and represent intensive changes that cross boundaries and fields. But the sea, and the changes that are occurring in ecological conditions, are not sufficiently understood by subjective practices alone. They can lack credibility and be overlooked or isolated. And yet subjective perspectives of art can be powerful at dealing with certain types of reconfiguration and potential change. At times they may not address the material conditions of change of which human action and the sea are a part.

On the other hand, there are problems with objective knowledge practices too and

how they ignore the involvement of subjects in what they address. Knowledge that follows the disciplinary approaches of natural science (including arts practices) can leave behind the subtlety and open probabilities of other arts knowledge. This division of practice and outlook is explained clearly with Latour's critique of bicameralism. Following this I have shown how Barad's methodology of diffraction can focus on the entanglements between these forms of knowledge-making in ways that acknowledges the potential for change in both.

Having established a starting point to access the problem of the sea, and a methodology to progress this research, the next step I will take is to make artworks that try to show something of the movements of complex change that take place within the sea. I did this through a series of exploratory drawings undertaken following sea swimming.

Chapter 2

Sea Swimming Drawings

In this chapter I will describe a first example of arts practice that attempts to approach or engage with thalassocentric conditions, to see how it may succeed or fail and in what way. This will offer an instance of learning which will be used to progress the research. Having discussed the problem of the sea, it is now possible to formulate questions to ask of this early example of practice and to see how the work is able to 'answer' those questions. In particular I can ask how artworks show connection, scale and change. Are they able to avoid an atomised form of enquiry? What does the artwork show of the human and the non-human? How does it relate intensive and extensive changes and which disciplines does it mobilise?

I will preface my artistic attempt to look at different ways of understanding entanglements of scale and change with an example of how entanglements are read by other practices. To support the method I have borrowed from Karen Barad, I quote her description of connected change on varied scales in a different context, that of a plane flight.

> 'During a transatlantic flight from New York to London, at a cruising altitude of thirty-five thousand feet, a communications link between an Intel-based note-book computer, perched on a tray in front of the passenger in seat 3A of the Boeing 747, and a Sun workstation on the twentieth floor in a Merrill Lynch brokerage house in Sydney initiates the transfer of investment capital from a Swiss bank account to a corporate venture involving a Zhejiang textile mill. The event produces an ambiguity of scale that denies geometrical analysis. Proximity and location become ineffective measures of spatiality. Distance loses its objectivity - its edge - to pressing questions of boundary and

connectivity. Geometry gives way to changing topologies as the transfer of a specific pattern of zeros and ones, represented as so many pixels on a screen, induces the flow of capital and a consequent change in the material conditions of the Zhejiang mill and surrounding community. With the click of a mouse, space, time, and matter are mutually reconfigured in this cyborg "trans-action" that transgresses and reworks the boundaries between human and machine, nature and culture, and economic and discursive practices. ' (Barad, 2007: 223)[x]

A sketch from the sea swimmer

This quote describes types of complex entanglements. It encourages a move from clear-cut geometry towards understanding intensive flows in changing material conditions. It is a departure point from which to produce and then 'read' sea swimming drawings. I will first describe the experience of sea swimming as a precursor to considering drawings done after sea swimming.

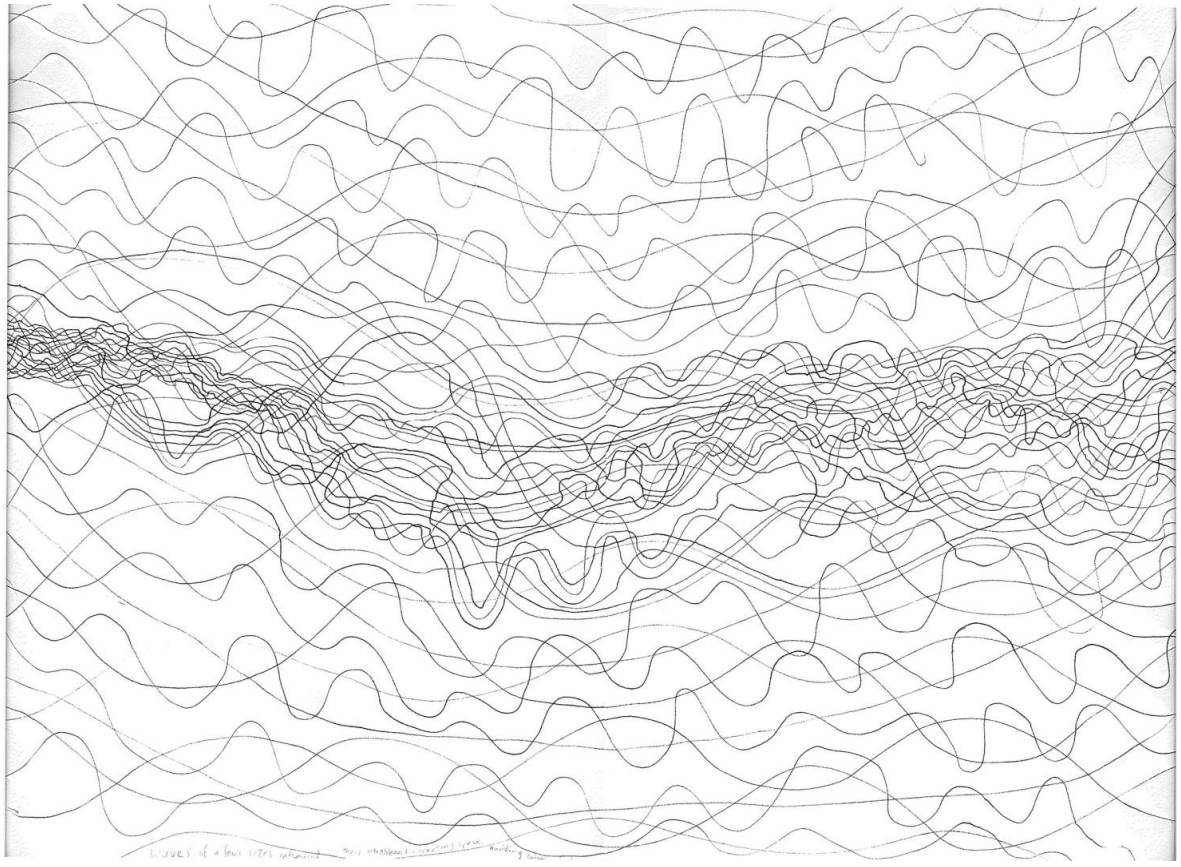

Fig 1. *Sea Swimming Drawing* (2013), ink on paper.

A body rolls and pitches on different axes while in the water. It bobs at a frequency

influenced by its mass, density and arrangement, oscillating around a centre of balance that is continually changing through its own cycles of a swimming stroke. While swimming, arms ‘catch’ and ‘pull’ in cycles with legs kicking at a half or a third that frequency. These cycles are taken into the waves and meet with, combine and subtract from them. The swimmer is slowed down or sped up as waves pass. Exhaling slowly over the time it takes to make three strokes, lungs empty of air and the buoyancy of a swimmer's torso decreases. As a result, the centre of balance moves and the head sinks lower. After perhaps three strokes the head turns and air is inhaled. The top half of the body becomes more buoyant, rises and tips up in the water again. All of this occurs amidst the movements of the sea, also changing the waves on a local scale and leaving ripples and splashes. The resultant movements and oscillations in multiple axes cannot be separated into those of sea and swimmer. The entangled process of swimming in the sea is affected by and changes the waves in which it takes place.

The experience, the reality of the sea is much more than the movement amongst waves though. There are other forms of intensive change. Other oscillations and cycles dip and peak. Having experienced an initial shock from the cold, the swimmer’s mammalian dive response reduces heart rate and constricts peripheral blood vessels (Bruce, Speck, 1978: 9). Exercise increases metabolism and generates heat in muscles, another change working in a different 'direction'. Lactic acid builds up and body temperature changes slowly as blood flows away from the extremities to the core of the swimmer's body. Breathing and stroke are affected by these temperatures and exertions. A swimmer may set off from finely sifted sand accumulated by the predominant, ocean-dominated swell. Such sand is often collected in bays of eroded, collapsed rock. Geological oscillations meet cycles of marine movement to configure this or other 'routes'. Moving into deeper water increases the ‘chop’. The movements of the body and arms would now have to respond to the depth below, affected by more distant wave patterns and deeper slopes of sediment falling away from land and slowly sinking towards the edge of the marine shelf. Returning to the beach, a swim route may pass through bands of floating kelp, which, having grown following its own circannual rhythms influenced by day length (tom Dieck, 1991: 341–350), is often torn loose by prior storms. Storm frequency has changed in recent years (Met Office, 2014); another level of oscillation overlayed at very different scale. This activity passes through and

registers many layers of interacting systems and scales of oscillation. Waves in metabolism, geology, algal cycles and physical movement stack on top of each other.

And a swimmer's short marine journey might describe a loop, returning to a beach that benefits from municipal maintenance and that is chosen for its easy road access. Many sea swimmers use neoprene wetsuits, silicone hats and polycarbonate goggles. This equipment is produced from oil and manufactured and traded globally. To warm up after an exhilarating swim, Cornish sea-swimmers often enjoy a hot drink from a local beach cafe; made from coffee or cocoa beans from Colombia or Kenya. They many not think of this though if they are basking in the rush of endorphins that accompany cold water swimming (Outdoor Swimming Society, 2014). As well as physical and material processes a swim in a 'natural' location depends upon and changes many areas of life, be they local or distant, social, political, economic or psychological.

How much of these multiple levels of change and oscillation, of investments and degradations in resource and energy can be included or registered as part of a thalassocentric perspective? An ecological answer to this question would seek to understand these processes of change, their interconnection and multiscale reach, in a coherent way that includes the non-human and the human. An art-based answer to this question might make these levels of changing oscillation visible in some way. Ideally this would bring to light many material relations, dependencies and changes in which the practice is implicated. Just how completely it is possible to follow these entanglements is another question entirely. The scale we see may not be easy to 'analyse' and 'measure' as Barad notes. And if it is possible to register it in some way, the result may be cluttered, untidy and noisome or uncertain. But the inclusion of this clutter and noise could still be a satisfactory outcome for an art apparatus.

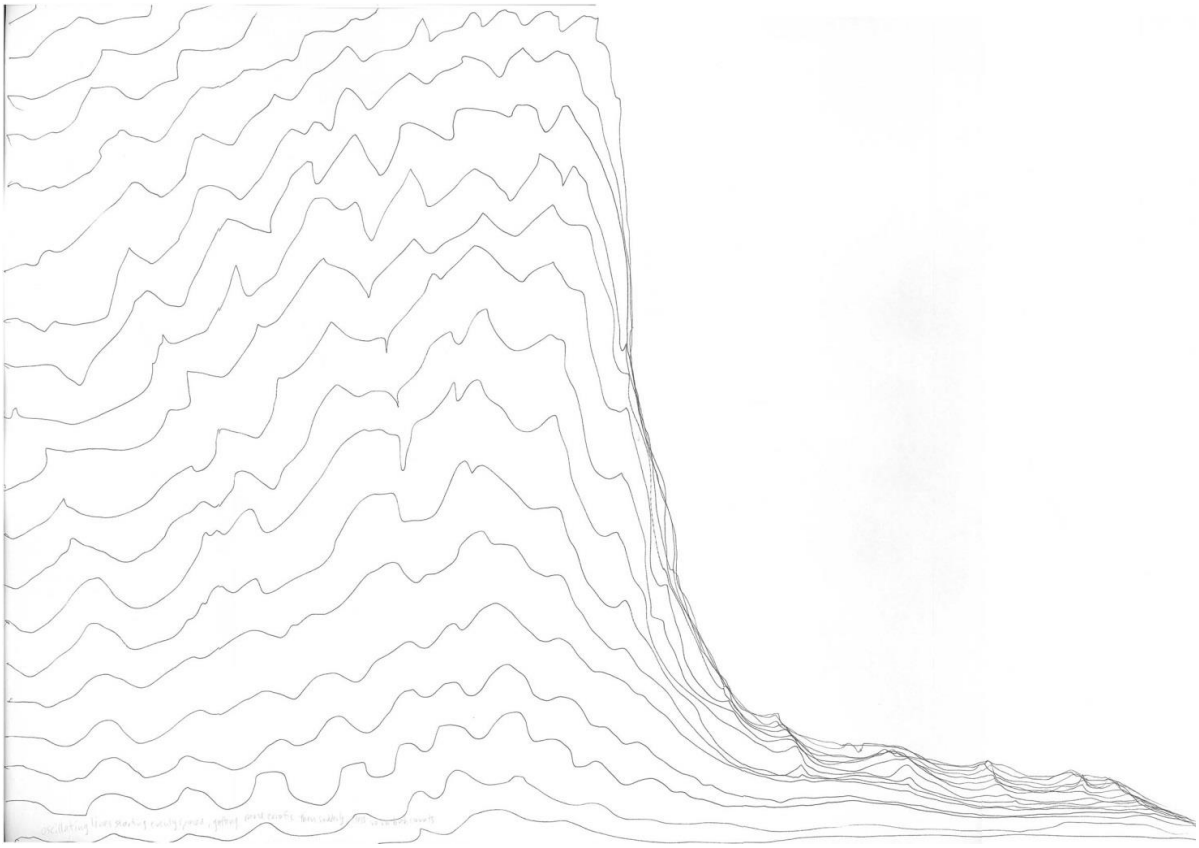

fig 2 *Untitled (2013). Ink on paper*

*fig 3. Untitled (2015) G*raphite on paper

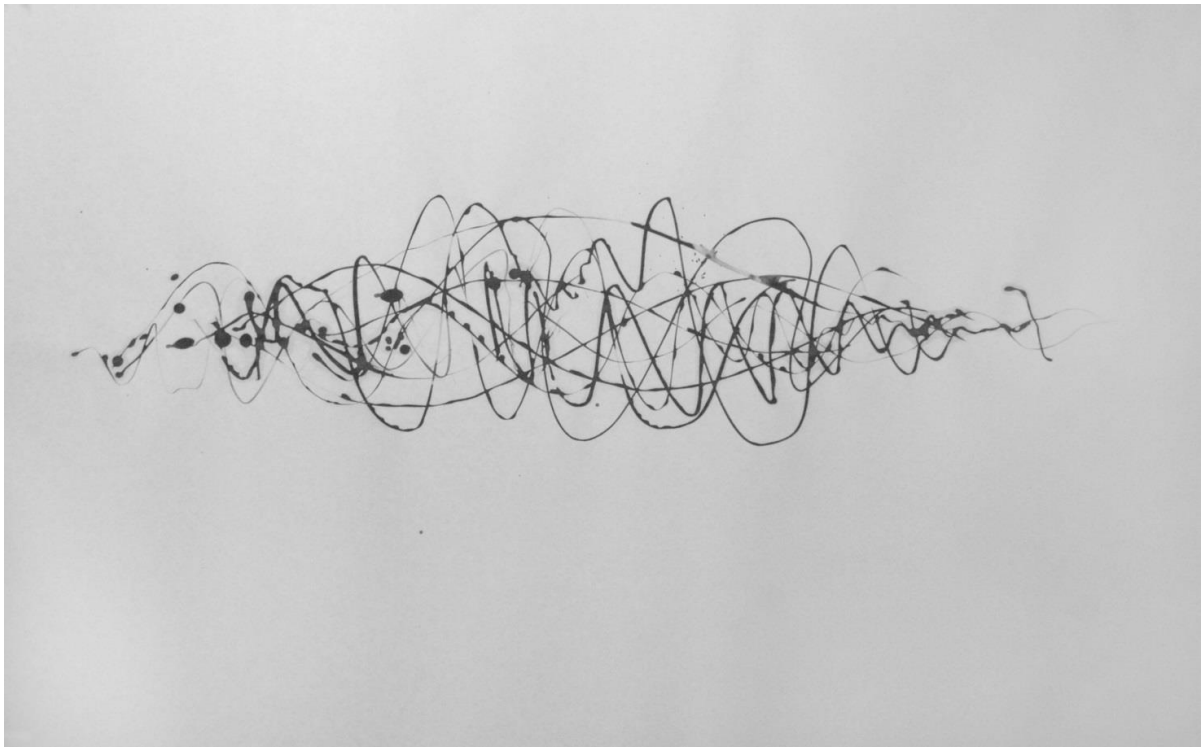

fig 4. Untitled (2015). Homemade ink (made using spoil from a Cornish tin mine and oak galls) on paper.

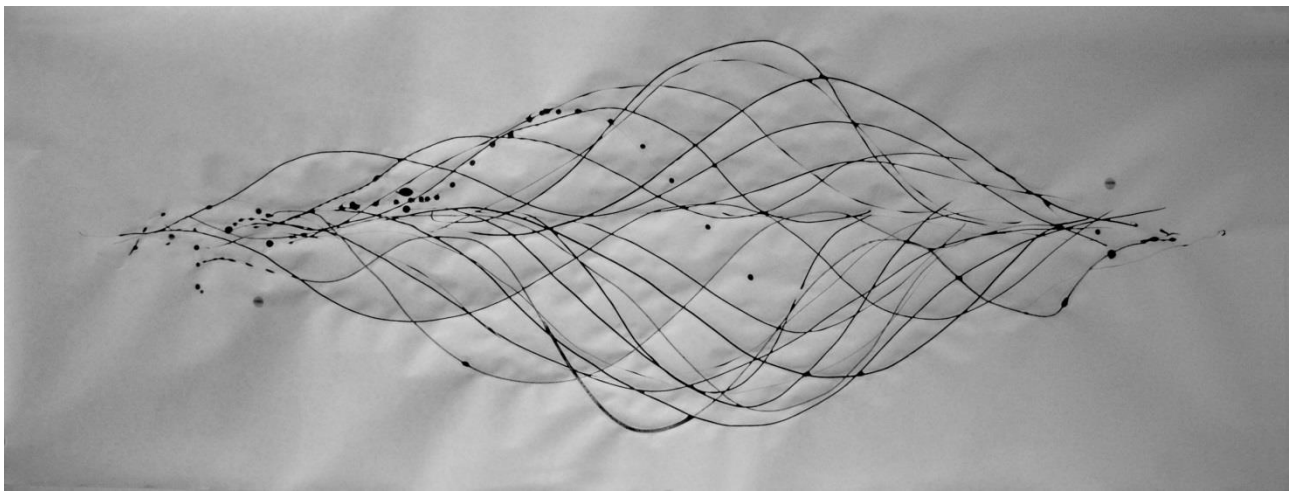

fig 5. Untitled (2015). Homemade ink *on paper.*

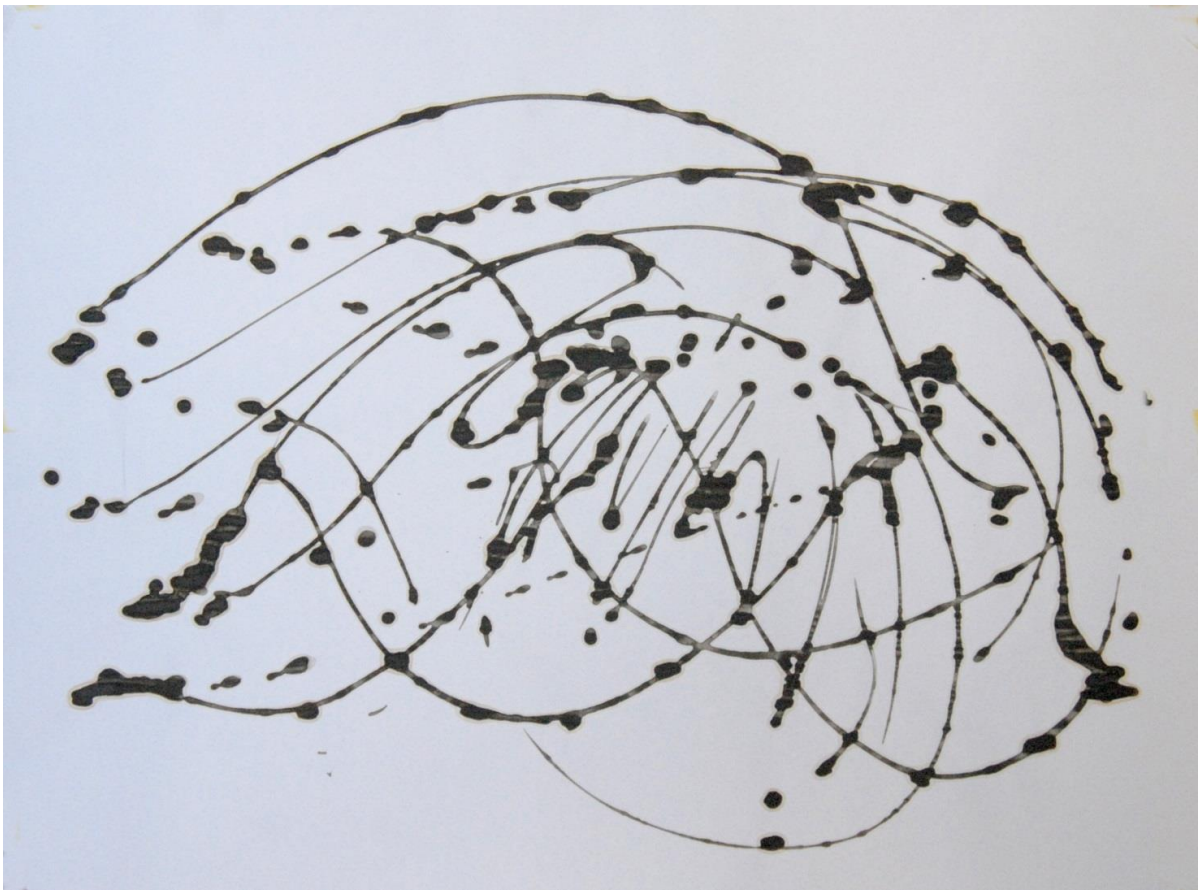

fig 6. Untitled (2015). Homemade ink on paper.

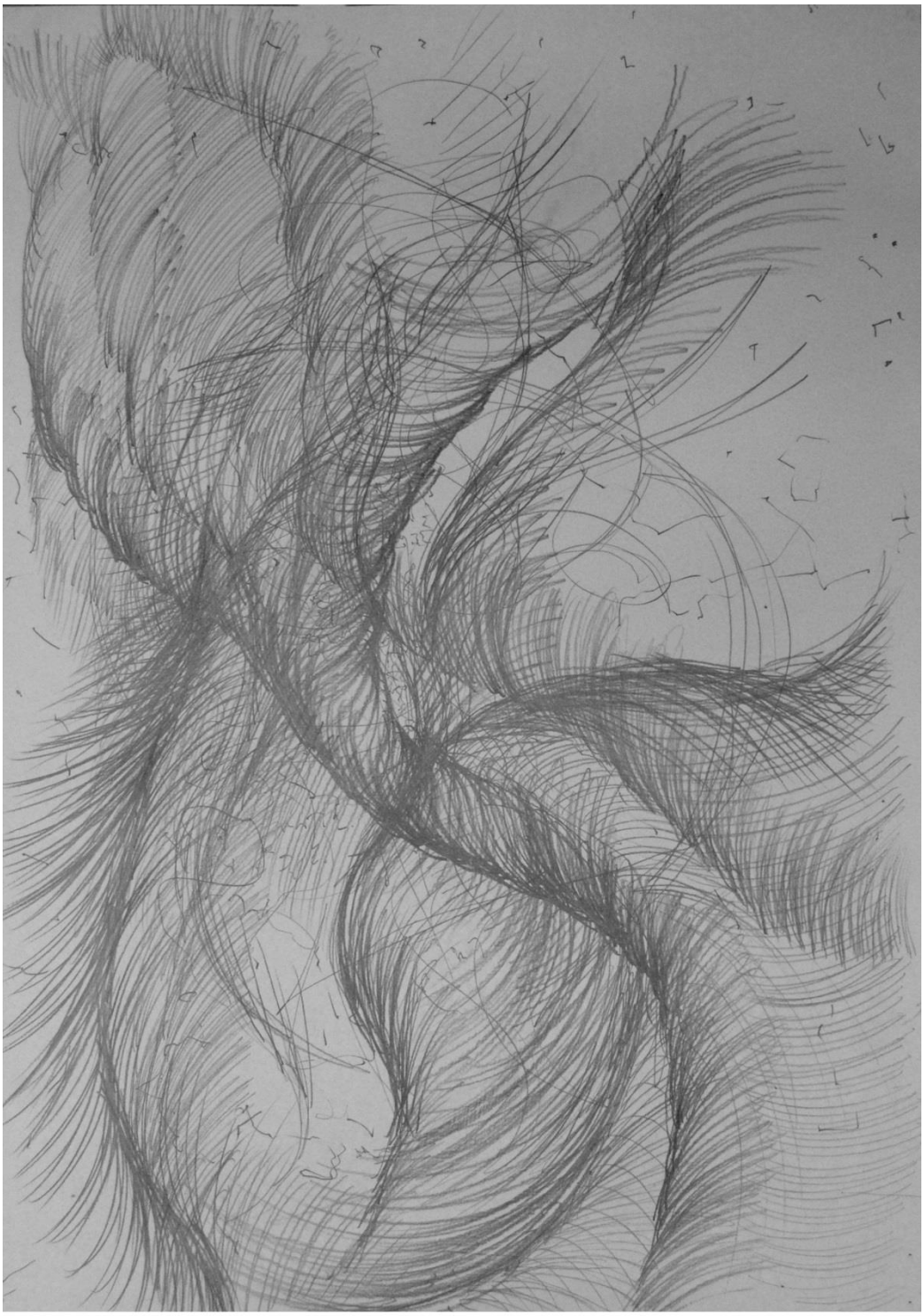

fig 7. Untitled (2015). Graphite on paper.

fig 8. Untitled (2015). Graphite on paper.

Comment on drawings

Taken together these works do succeed in showing something like the complex, varied oscillations of the sea. Just as sea conditions are extremely variable, so the drawings move between very subtle, almost invisible series of marks, to the portrayal of much rougher conditions. They exhibit a sense of eddy and rhythm that doesn't repeat exactly, but progresses and changes over varying periods (whether from line to line, or from section to section). There is a sense of movement and change existing beyond the frame of the drawing, or outside its plane of visibility, suggesting bottomlessness. The things the drawings depict may be too soft to register, or only a very local experience of something much bigger. This is much like the experience of swimming in a vast, restless sea with limited visibility.

The ink drawings explore how waveforms of multiple length can combine together in a noisome, complex, yet coherent pattern. Like the cleaner line drawings (figures 1, 2, 4, 5, 6), they start to evoke the wave-like movements of other systems besides the sea. These drawings follow the influence felt by one wave on another, and the juxtaposition of multiple waves of varying scales.

These line drawings show events of individuation. Each line arises in response to its predecessors and its surroundings. Emerging lines have a ‘desire’ for surrounding negative space, to avoid clutter, or rather that part of my awareness that controls the line has this desire. In this sense the marks relate to a body of subjective perceptions that are also complex and multi-layered. Every line, or spot, influences the activity in its localised surrounding’s emptiness. It is as if the mark pulls itself into being by emptying the possibility of existence from its near proximity. If lines do cross, they cross in a way that suggests multiple layers or planes.

A sense of multiple scales is suggested by the drawings. Boundaries (like those of transitions between rock and sand, flat calm and rough) have been exposed and traversed in the drawing process by a slight push in the elastic responsiveness of a line to its predecessor (eg in fig. 2). They do have emergent sensibilities that might be recognised in systems other than the movement of water, such as flocking starlings or stock market crashes.

The ambiguity of reference within these lines allows multiple readings. I can start to

employ a diffractive method to bring new knowledge into combination with the drawings. For instance, reading these drawings against ecological theories of system behaviour (a theory which I will describe in greater detail in following chapters), we can equate these drawings' distribution of line and space with a system’s dominant rhythms. Ecosystems have significant temporal structures deriving from the cycles of day, season and 'life cycles of keystone species' which result in 'temporal lumps'. Those temporal lumps can be seen as similar to the rhythm and spacing between lines in the parts of the drawings that display more emergent shapes.

Small changes (whether lines or environmental events) build up to show emergent behaviour on larger scales. At times the system of lines moves to other states – again this is similar to ecological behavior. In ecology, changes that are 'beyond the tolerance of the available species pool' (Westley et al, 2002: 106) can precipitate much greater structural change, perhaps resulting in a new stable state or boundary transition, perhaps precipitating a form of species collapse. A hot day prompts well-rehearsed changes in local behaviour. A hot century may prompt changes in species composition. This property of emergent and entangled systems is seen within this drawing approach. Mountainous regions can transform into flat planes. A wave can ‘dump’ a swimmer, stable conditions can collapse on other scales.

These works derive from many events happening at the same time. The outcome of the drawing is representative of the process and the experience of an individual who is immersed in the Cornish sea, but it is also representative of (at least part of) a systems perspective that implicates many scales of the human and non-human world.

Many processes are recognisable concurrently while making the drawings. Working through this process of emergent meaning and structure evokes and represents memories from the experience of swimming, but also from reading and other forms of research. The artist's hinterland of skills and experience is used to animate the drawing process including knowledge of complex systems behaviour and the memory of swimming. Some of the drawings might evoke the experience of a lone artist abroad in larger-than-self conditions. Others share similarities with a more analytical or objectified (albeit noisome) approach to trace and mark (an almost

graph-like approach, although as seen below, an engineer's plot of sea movement is very different). These drawings are starting to work across the different 'cameras' of Latour's problem, but they do not represent the different halves (the two poles of object and subject) equally. A question arises. Should they move towards the subjective experience of being in the sea, or should they seek to represent its movements and processes in a way that connects with understanding from material sciences? This remains unsettled within these works and must be addressed in subsequent work.

Combining the process (swimming) and output (drawing) as a way of talking about intensive and connected systems in and around the sea asks a lot. It requires recognition of a similarity between subjective processes such as drawing skills as well as processes described by oceanography and geology. It is not easy to connect these very distant disciplinary forms of knowledge.

If we were to accept the ambiguities of reference suggested above (are the drawings about sea, ecology, or other things?) we might say the drawings do not differentiate between the importance of one realm of oscillation and another. They address types of movement and change that are common in multiple conditions.

Despite the potential for this method to resonate with ideas of the complexity of the sea and of the anthropocene, there are problems. I describe the drawing process as if the artist were not present, as if the line itself were making the decisions and was the agent of its own manifestation. An important insight from Barad's theory discussed above is that the apparatus is an important site for relating different types of knowledge. The apparatus of these drawings is not very clear.

This is a way of speaking that owes much to description of scientific processes; as if these changes were written directly by an objective world, through impartial instruments as is the claim for scientific practices. This drawing cannot be used to support truth claims about specific ecosystems. It is inescapably driven by the choices, background, training and references of the artist that made it. Knowledge of changes in complex systems (through research) and experience of the special conditions where water and land meet were part of the inputs for these works, as well as time spent in the sea.

And even more tools were used to produce these works. They are complex embodiments of the artist-swimmer that made them.

Concentrating on the emerging character of line - developing an empathy with it - brought a range of subjective tools to bear on the process of drawing. Novelty, boredom, tidiness, clutter, denial, humility, impatience are mobilised in ways that are not easily managed or measured. Micro-experiences position the human artist within a partially controlled, yet largely open system (a drawing) which aspires to some degree of empathy (through memory and playful speculation) with another system (the Cornish sea). The execution of this drawing calls upon a set of skills developed through artistic practice, including recognition of varied types of theoretical ideas. These works can also be seen as the product of a tradition of individual artmaking learnt in academies and other disciplinary communities. These practices of knowledge-making form another hidden material hinterland, of the 'apparatus' that executes this work. This comparison, or diffraction of different types of knowledge has highlighted how important it is to better understand types of apparatus. I do that more fully in the next chapter.

While the arts process (embodied through the artist-swimmer) might develop some form of connection with the complex systems around the sea, the strength and significance of this connection is uncertain. This might easily be interpreted as a drawing of imagination, separated from the material world. This reading would let the artwork revert back to an exclusively subjective act; entertaining, but easily dismissed as having little purchase on material conditions in the real world. This would put art back in the half of a dualism that separates arts practices from material conditions normally described by scientific practices.

Engineering Practices

As a contrast to my arts-based approach to sea drawing, it is helpful to present perceptions gained from other practices, such as engineering and see how *they* register the movements and intensities of the sea. Engineering is a clear example of a knowledge practice directed towards objects and materials. Marine engineering companies developing renewable energy at sea undertake research into the suitability of the seabed for installation of energy-production equipment[xi]. One of the

key issues influencing the viability of offshore energy-generation projects is the ability of industrial plant to withstand forces to which they are subjected in marine locations.

Cornish company Mojo Maritime develop marine renewable technologies. Mojo produced an array of values for the estimated tidal velocity for a location off Falmouth during the year of 2012. This data set, when plotted shows a curve that oscillates (see figure 10).

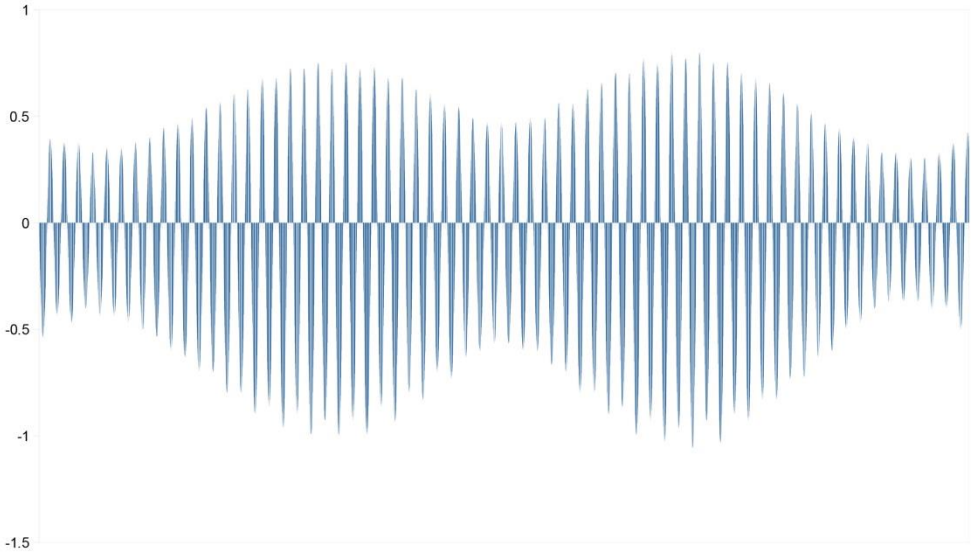

Figure 9. Tidal Current Velocity (Walker 2012)

Tidal velocity - the ebb and flow of the seas - varies over time with high and low tides twice a day. These changes also vary in that the low point and high point of tides get lower and higher at different times (due to spring and neap tides, caused by the waxing and waning of the moon). And in turn these spring and neap tides get more and less strong at different times of the year. So looking at tidal flow over time

again shows us a form of change within change, taking place on different nested scales. Furthermore, this pattern of variations is exacerbated or dampened based on the location. The volumes of water changing place vary according to a range of conditions. The vast movements of water back and forth between seas has its own periodicity in different 'basins'. So values of tidal velocity (or projected estimates) are location specific.

This graph might be thought of as a form of drawing of the intensities of the sea. It too might be considered thalassocentric. Reading this plot, each point on the graph shows a rate of movement of the sea. The information shown on the graph does not give a position for a sample of water, but the speed of its movement). As the line moves from above the horizontal axis to below it, a change in current direction is represented (one tidal period). The speed and size of change grows and shrinks. This 'order' of growth also oscillates according to lunar cycles. We see a wavy wave (constructed from waves). At every level the conditions of the sea seem to be shivering. Again the multiple scales of stacked oscillations are visible. A complex weave of *changing change* is presented, taking place over many scales.

This 'drawing' helps to answer two very specific questions of critical importance for such marine engineering projects.:

- W*hat is the maximum force a device tethered to the seabed at a particular location would have to endure?*
- *Is the flow of water of sufficient energy to make a generator economically viable?*

The drawings undertaken as artworks are all constructed from a combination of linear waves or curves, like the engineer's thalassocentric drawing. But they differ in many respects.

In order to approach a world that is radically non-human in many ways, the swimmer, and even more so the sailor or the researcher, depends upon a range of technologies, devices and socio-political accommodations. The experience is the product of globalised industry and commerce, local and national politics and civil and cultural infrastructure. Any knowledge or effect that is attributed to this act of going among the waves, is also part of a series of effects that return (at some point,

at some scale) to impact upon the site under question. My own drawing-based experiment in marine research required a neoprene wetsuit and polycarbonate goggles. Larger scale, industrial research processes require diesel-powered launches, specialist devices and software, research funding and attendant political support. To venture into the sea to study it and its lifesystems will at some point influence those systems. Can these actions be considered separate from the causes of ecological change? Again, looking between the different types of knowledge and how they affect each other, the significance of the apparatus used to make the work becomes important. In the engineering 'drawing' the apparatus is not addressed. And in my artistic drawing, it is not sufficiently addressed. But looking at the apparatus that produces the work is helpful in both cases.

Conclusion of practice evaluation

A thalassocentric perspective must be developed from layered and highly connected conditions. Looking at the connections traced above by Barad's description of a computer transaction and by the description of a sea drawing process that started this chapter, we know that engineering approaches fail to register the necessary breadth of connection. The very specific answers required by engineering projects are not a sufficient approach.

On the other hand, in comparison with the plot of tidal velocity over a year, the drawings appear inexact. They do not replicate quantitative values. They are wider and more open in their engagement and 'reading' of the Cornish sea. Compared to the demands of clearly defined engineering project, an arts-based approach clearly does not claim an exclusive focus on the object of the sea. But should this condemn them to be purely subjective, and in that case of limited value dealing with a material world? How can drawings or other arts practices offer credible knowledge about the behaviour of material change in the sea? This point is more about the constitution of disciplinary practice than it is about these drawings alone.

Considering the aim of engaging with multi-scale connections and changes that include human conditions, then these drawings are limited in their success. To a significant degree, they leave in place the bounded frame of engineering projects, even if they start in the opposite 'camera' to that of engineering.

The material conditions that give rise to them could be overlooked in the drawings. How did they come about? The knowledge and perspectives that they portray are products of a particular time and set of circumstances, as are the resources used to undertake their production. The experience of the artist in the waves can still be a linchpin around which these multiple entanglements are registered, but they have not been made visible on this occasion. How could they be made visible?

In the case of these drawings the tools and resources used to produce them include, but are not limited to paper, pencil or pen, swimming equipment (goggles, wetsuit[xii]), but also the means of access to the location and skills and perceptions. This drawing activity is dependent upon many economic and industrial processes that are implicated in environmental change. It is also dependent upon a deep and wide hinterland of academic and art world infrastructure and tradition that has provided many years worth of education, knowledge and other support.

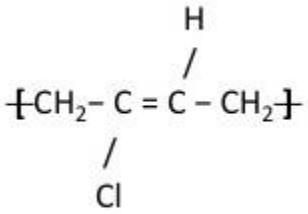

Fig 10 *Repeating unit of the carbon-based polymer neoprene produced by the chlorination of butadiene or isoprene. (Encyclopedia Britannica, 2014). The wetsuit is for many all year sea swimmers an essential part of the equipment that enables their activity. It was an essential part of the apparatus for these drawings. If immersion in the sea is attempted in order to register the connected changes on many scales (changes which ask many questions of unsustainable industrial manufacture), then ignoring the presence of such materials and processes and their implication in the drawings seems inappropriate. Neoprene was, in some way part of the apparatus of these drawings.*

For these works the processes of production, the apparatuses that were used, were insufficiently visible. But in one way they were addressed to some degree. Attempting to make the drawings more relevant to location, I produced ink from local

materials. Figures 4, 5 and 6 used that ink, which was made from the transformation of local sustainable materials (mine spoil and oak gall). In particular the 'waste' from processes of nature and industry are reused in a new process. A collapsing wave of material use then becomes a new wave of emergence. Mining becomes art, as does parasitic predation of an oak tree. The paper used for these drawings does not also take this approach (attempts at making paper from recycled drafts of research writing were successful, but did not result in a 'high quality' drawing surface). But the issue of the materiality of the work and its process offers a productive direction for new works in other materials, the emergence and collapse of which could be seen as a wave.

It now becomes clear that this research should aim to include, and in some way make visible, the apparatus that produced the artwork, although what that apparatus consists of must be clarified.

The disciplines mobilised by these particular works involved swimming and drawing. They used a form of performance swimming that showed many things happening at once at different scales. I find that this is an appropriate way of approaching different types of material behaviours and trying to relate them to the skills of the drawer. But I also find this approach is too dependent upon settled artistic traditions to allow space for many of the most relevant questions that need addressing. The visibility of the practice and infrastructure it came from should be more closely considered within the drawings. The works borrow perspectives from oceanography, and complexity science. Yet they only do this in suggestive ways that use a hidden subjectivity. The artist's practice acts like a black box connecting these forms of sea-like movement. And yet this black box uses and requires tools and accommodations that are relevant to issues we are looking at.

Summary

The drawings undertaken here have provided images of types of wave-like change. Behaviours familiar from the sea (but also from other conditions) are recognisable. Wave patterns may fade to the edge of visibility. Shapes may repeat over larger or smaller scales. Repetition and slight change can build up to radical change as if a boundary is crossed. Emergent patterns with life-like characteristics can be found between the chaotic and the uneventful. These works have managed to draw

together insights from a range of sources that can be returned to the research process. Thalassocentric shapes appear clearer now.

The works do show the material conditions of the sea in some ways. They succeed in portraying an immersed perspective that can pertain to non-human, material properties and intensive properties. The drawing process highlighted how art making is entangled in many processes even if it couldn't easily show them. The neoprene and coffee that was attached to the act of drawing and (at some scale) its impact upon the sea it looked at, were relevant, yet completely invisible. This stage's findings contribute productively to the research. The works offer insights through their successes and through their limitations.

Both process of production and the drawings that result show extensive and intensive types of change that could be connected. This is useful at this stage. And in the drawings it is not possible to tell if they address intensive or extensive conditions.
But it is not possible to be sure these intensive realities are meaningful – or real. It might just be decoration. This disciplinary combination lacks material credibility that is part of science's objective method. And the socio-political realities that are discussed above are nearly invisible in the drawings, even though they are used and noted in process.

The hinterland of process behind these drawings (including wetsuit, research tools and many other resources) is not sufficiently visible. The foreground of material change is not presented in a credible way, and could be dismissed as purely subjective. However the drawings speculate in a useful way on how a wider range of contexts move and change.

Having considered the abilities and limitations of this approach, I conclude that the technologies such as tools, devices, craft as well as infrastructures and processes of research and communication, are still too separated and atomised when using this particular drawing approach. The outcomes and discussion of this practice propel us towards an investigation of different forms of apparatus, how they combine and connect.

Chapter 3 Apparatuses

artworks that explore connected change over scale and that include subject

The need to access distant, difficult or ambiguous truths calls for 'tools' (either technical or procedural), for instance to perceive change and connection over scales. I call these *apparatuses* and in this chapter I will look at different forms and understanding of 'apparatus'.

Apparatuses are used in the sea to help approach elusive conditions there. The elusive nature of the sea was made evident during a workshop for artists with scientists conducting seabed surveys (a practice known as Bathymetry, lit. measurement of the deep). This took place for the Falmouth University event *Geohack*, part of the three-day conference *Fascinate 2014*. Presentation from the scientist Neill Wood described the varying densities and temperatures of water at different levels. That, and water's opacity and resistance to penetration by certain wavelengths of radiation mean that collecting and interpreting data of the deep can depend upon much equipment, and lots of interpretive skill. The results can still be uncertain. The conditions of the sea are elusive. The location or identity of objects cannot be pinpoint

ed with exactitude (Geohack Seascaping Map: 2014).

These elusive conditions are even more significant when viewed from on land. It is not easy, or perhaps possible, to develop a thalassocentric perspective from a land-based standpoint. A different space of perception needs to be achieved. This is either a space that is somehow in the sea (as with the drawing discussed above, or scientific processes which use remote instruments or traces, so making distant locations somehow closer), or a conceptual space whereby the intensities of the sea are shown in other ways.

But how can arts practices engage with these elusive conditions and in what sense do they use apparatuses? I have already started to ask in what ways practices must be conducted from *within* the sea; how much of the artist must be immersed (hand, body, eye, mind) and which devices and technologies? This becomes a question about the tools used and developed for the production and control of knowledge – apparatuses – and how they work alongside the humans that operate them. I have introduced Latour's observation that apparatuses play a special role in creating an apparent division into the world of people and the non-human world. This was developed from the work of Shapin and Schaffer (Latour, 2009), whose work I discuss below.

Considering this, and recalling Barad's airplane passenger description (above) of entangled socio-technological arrangements, apparatuses can be thought of as tools (in the broadest sense) and collections of devices and technical and cultural arrangements. They clearly stretch across boundaries in much the same way as the intensities of the sea itself. Apparatuses may be described through sociological, or scientific terms. It is my intention that discussion in this chapter should help develop an understanding of apparatus that works through these interpretations to develop the terms of artistic and thalassocentric apparatuses. To be fit for our purpose, such an apparatus must acknowledge conditions of the sea that we have started to elucidate above, engaging over scale and boundary at different scales and engaging with multiple realities. It must be sufficiently cultural to allow the subject to be visible in some way. It must engage credibly with material and non-human conditions sufficient for it to register the changing conditions of which the sea is part. And it must acknowledge its own place within these entanglements.

I will start by quickly reviewing relevant insights from the sociology of science then in turn compare Foucault's notion of apparatus and post-human understandings of apparatus (as discussed by Flusser and Karen Barad). These comparisons draw attention to how the object that is looked at (be it an item, or set of conditions) and the subject that does the looking, are made visible or ignored at different times by these different conceptions of knowledge production. The post-human version of apparatus (discussed after the scientific and Foucauldian versions) will start to entangle these two positions of object and subject in helpful ways for this research and so progress a model of how an artistic apparatus might operate in a thalassocentric manner.

1st Scientific Apparatus

The role and appropriate use of science is of great relevance to these issues (Latour 1993). Challenges to the authority of science centre on the question of its objectivity.

Shapin and Schaffer (1985) developed a social science critique which addresses the social formation of scientific discourse and knowledge making practices. Dealing with the centrality of the air pump and the constitution of experimentation as a social and political activity they consider the construction of modernist science and the role of apparatuses. They contextualise this process within the historic disagreements about empiricism at the time of the English civil war. At that time understanding of the properties of air were being decided through methods of argument and experimentation. This was a process that was going on at the same time as arguments about the nature of governance and the formation of political bodies. Shapin and Schaffer's key argument is that the models of deciding knowledge about natural foundations of our world influenced approaches to issues of political uncertainty. To put it in their words, the ‘Solutions to the problems of knowledge are embedded within practical solutions to the problem of social order’ (Shapin and Schaffer, 1985: 332).

Shapin and Schaffer develop their account around the role of instruments in science, showing how the 17th Century was a formative time in the history of scientific instruments and our ideas of what they can achieve. They describe how

the truth claims of science were increasingly supported by tools that extended and augmented human senses. Unassisted senses were less able to 'straiten (sic) the recesses of nature' (Hooke, quoted Shapin, Schaffer, 1985: 36), and instruments were used as 'inlargements (sic) of the dominion of the senses' (ibid: 36). Tools were brought in to produce knowledge because they were thought to do better than human insight alone.

Shapin and Schaffer suggest the air pump used by the scientist Boyle at the time is presented as a credible non-human witness to a nature that – when it speaks – appears free from the taint of politics. Because the knowledge that is shown doesn't come from people, people can't argue with it. It is as if the world itself has spoken. As we have seen, this acts as a form of separation which according to Latour, ensures there is 'no possible continuity between the world of human beings and access to truths "not made by human hands"' (Latour, 2009: 15). Matters of objective fact can now be settled without the trauma of political discord that had just caused a civil war.

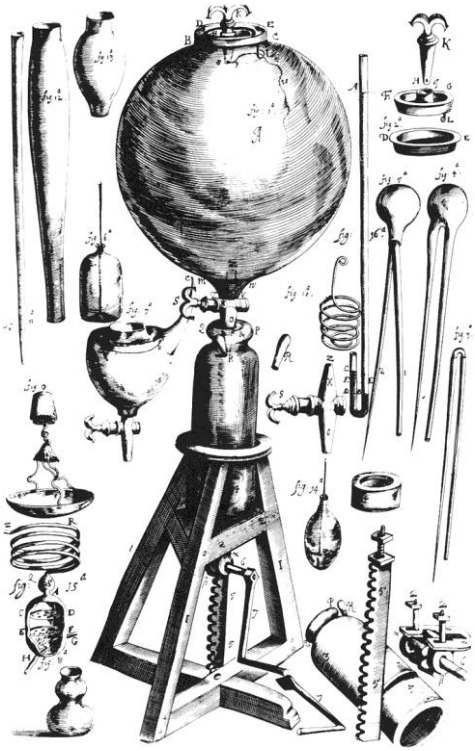

Fig 11. Air Pump

Boyle’s air pump became ‘emblematic’ and iconic in itself. A series of engravings including the motto "To know the Supreme Cause from the causes of things" feature the pump as a tool that is explained as enabling ‘the philosopher to approach God's knowledge’ (Shapin, Schaffer, 1985: 32).

Such an apparatus is described as an early model for scientific method. It is presented as a producer of objective facts, able to reach beyond the limits of human senses into further reaches and more elusive realms. The air pump can tell us about the nature of air and vacuums. Shapin and Schaffer make the point that knowledge of nature was also about matters of social credibility. Despite being directed towards material objects, this interpretation of the apparatus is socially founded and (according to Shapin and Schaffer) it does a social job, by denying its social or human influence and the social origin of the apparatus.

Shapin and Schaffer's description of the separation between matters of humans and matters of nature is adopted and extended by Bruno Latour as a form of 'purification', which attempts to keep 'houses' of knowledge from cross-contaminating each other (2009). This is a dualist distinction that tries to produce hard, solid facts that exist free from human opinion, resulting in knowledge that Lorraine Daston says appears as undeniable as rocks[xiii]. Other configurations that allow more fluid types of knowledge are clearly welcome given the context of this research.

I have shown here how a scientifically-constituted apparatus is presented as being objective when it operates. It is claimed to collect material data about a natural world that is separate from human confusions and it does this in a way that is not tainted by the subjectivity of society. It is necessary to conclude that this model of knowledge-making perpetuates an unhelpful dualism. I have already established that a thalassocentric apparatus must relate and connect human and non-human, since the human and non-human are entangled in the sea in ways that are relevant to ecological changes of the anthropocene. The next version of apparatus that might be useful for this research does not claim to be separate from society. However, I will show how it does not fit the needs of this research either, being interested in subjective conditions, but not sufficiently in non-human conditions.

2nd Foucault's Apparatus

Foucault describes a different understanding of structures giving rise to knowledge and its associated power. Foucault's dispositif, (which has been interpreted to translate as apparatus (Agamben, 2009)) is constructed in terms that foreground subjectivity, which was invisible in scientific apparatuses that claimed objectivity. Rather than being ignored, the role of society and politics are made central. This renders a study of apparatus as a powerful way of considering discourse, social disciplines and orientation. We can see it is bounded to fit neatly a societal world of law, education, medicine, industry (Agamben, 2009:14). Such an apparatus extends and constructs structures of power and cultural and historical sediments through multiple realms. It successfully crosses boundaries in ways that approach some of the thalassocentric conditions we require.

This gives a powerful reading of the entanglements of society that include art making. It is an approach that has been developed in many ways including to describe art institutions and galleries as disciplinary apparatuses. The art institution is an apparatus that extends into the tourist economy, through global brands. Any independence of voice is 'consumed, merchandised and spectacularised' (Beech, 2006).

Following Foucault's reading, the apparatus is a producer of subjects. It can be anything with

> [the] ‘capacity to capture, orient, determine, intercept, model, control, or secure the gestures, behaviors, opinions, or discourses of living beings. Not only, therefore, prisons, madhouses, the panopticon, schools, confession, factories, disciplines, juridical measures, and so forth (whose connection with power is in a certain sense evident), but also the pen, writing, literature, philosophy, agriculture, and – why not- language itself...' (Agamben, 2009: 14)

This form of apparatus opens up social realms to visibility and investigation. Foucault's understanding of apparatus would show the social formulation of the tools used by Boyle. And it can also examine processes of knowledge production too. It can help us see the institution that helps the marine scientist fund his launch, as well as the art school and art market that help configure the artist's method. All of these factors could be considered relevant to processes of change that take part in

and around the sea. All of them are part of the conditions of the anthropocene, if we consider the socio-economic conditions occurring in the contemporary world as part of the anthropocene. And it is hard to escape this conclusion, as demonstrated in previous chapters. So these tools, an understanding of Foucault's sense of apparatus, can help trace the hidden processes of change that were not visible in works such as the sea drawings. If Foucault's insights help understand subjective conditions, do they still help us access the elusive non-human ecologies and processes, that 'objective' science is able to access with such power? No, this theory moves from one of Latour's cameras to another. It does not move between them.

In as much as Foucault's apparatus deals with the non-human world, it does so as a means to foreground and ultimately control the human; as a way of returning to talk about subjectivities again. It turns away from the non-human object. This apparatus is a tool of societal governance. It produces subjectification or, when failing to do so, ‘becomes a tool of mere violence’ (ibid: 19); and we can only presume this violence is measured against its human impacts (ibid: 14) rather than the impacts on non-human systems being considered.

So while we can accept that subjectivities are produced by social apparatuses spanning many, and perhaps all societal processes, it is important to recognise that is not all they do. Instead of apparatuses being 'Devoid of any foundation in being' (ibid: 11), ecological crises show us that apparatuses can and do engage with and register a world that extends beyond the human. Climate change, species extinctions, ocean acidification and many other issues are intimately connected with social conditions, but they cannot be thought of as purely social. They must be considered as both human and non-human.

Just as a denial of the societal foundation of scientific knowledge-making fails to escape an unhelpful dualism, so a construction of our place in the world that only considers the acts of societies and the subjects within them does not recognise material realities of the non-human. To constrain the apparatus as purely social will miss the reality of ecological change.

Loss of objectivity: exclusive subjectivity?

The point is that a challenge to the objectivity of science cannot remove the object. While the construction of knowledge of the ecosphere cannot be said to be objective, in the sense that it is incontrovertible, or separate from cultural systems and beliefs, that still does not mean that knowledge is a subjective product alone. To challenge objectivity is not to fracture the world into as many perspectives as there are possible views. The challenge to assumptions of objectivity posed by ecological change and our role in it does not call for us to erase the idea of object or subject, but reconfigure their relations and fixity. Extended to disciplinary practice this would also reconfigure our understanding of and relation between non-human and discursive knowledge.

This short comparison establishes the relevance of subject-object relations represented by apparatuses and the disciplines that use or describe them in different ways. These two treatments of apparatus offer separate accounts of knowledge-making which fail to address the connectivity between realms that include people and natural systems that are significant for ecological thought in the anthropocene. Previous chapters have used history, science and cultural disciplines to show that it is across these (and other) realms - and at different scales - that thalassocentric connections move and change.

We have already seen that isolation of object from subject should not be part of ecological knowledge-making. The approaches of Flusser and Barad, which I turn to next offer another direction for considering apparatuses. A post-humanist account of the apparatus considers both objects and subjects. Yet the relation and creation of objects and subjects is variable, indeterminate and co-produced. It is in this sense that I am exploring how the artwork might act as an apparatus. I do that now, firstly by looking at what Flusser terms a 'telematic apparatus', then by moving to Karen Barad's post-humanist interpretation of an apparatus.

3rd Post-human apparatus: Flusser

Vilém Flusser developed an understanding of the camera as a form of apparatus that could simulate, extrapolate and extend the body and its senses (Fuller, 2005: 55). I will offer a short description of this idea now. Flusser's is described as a 'postinstrumental apparatus' (ibid: 55), which offers a set of possibilities, which

amount to a kind of space or 'domain', which the user can navigate through and realise the parts thereof. The non-human parts of Flusser's technologically-framed apparatus are given a type of distributed agency of their own. It is this distribution in space and time which he calls 'telematic'. The user controls the apparatus, but is also controlled by a complex network of acting events and parts (and their impenetrable interiors).

Flusser describes these interactions, where the camera produces photographs and the photographer 'plays', as '*programs*'. And there are more *programs* associated with the camera than these two immediate ones. The photographic industry is another *program* which 'programmed the camera'. The photographic industry is itself programmed by industrial society - yet another *program*.

This description of the apparatus of the camera shows us that technology is constructed by 'forces and drives' and in some various ways it intermeshes with a range of other objects and phenomena, including economy, human beings, chemical processes and aesthetic forces (ibid 56). Flusser's apparatus is a 'complex plaything, so complex that those playing with it are not able to get to the bottom of it' (Flusser, 2000: 31).
The apparatus has its own life then. It acts and changes and in some way things happen inside a space of possibility that it constructs. But is this reading of it sufficient for this research? Fuller uses a series of photographs by John Hilliard, to consider Flusser's apparatus (Fig. 13).

The camera photographs its own process and its own set of possibilities. 'The program of the image is both built and erased by the apparatus that composes it. In “photography,” the proper use of a camera, the degree of darkness or lightness of the image, indicates the closeness to or distance from sources of diffuse or direct light of the object being photographed. Such use of the apparatus is here revealed as being precariously lodged between whiteout and blackout.' (Fuller, 2005: 60)

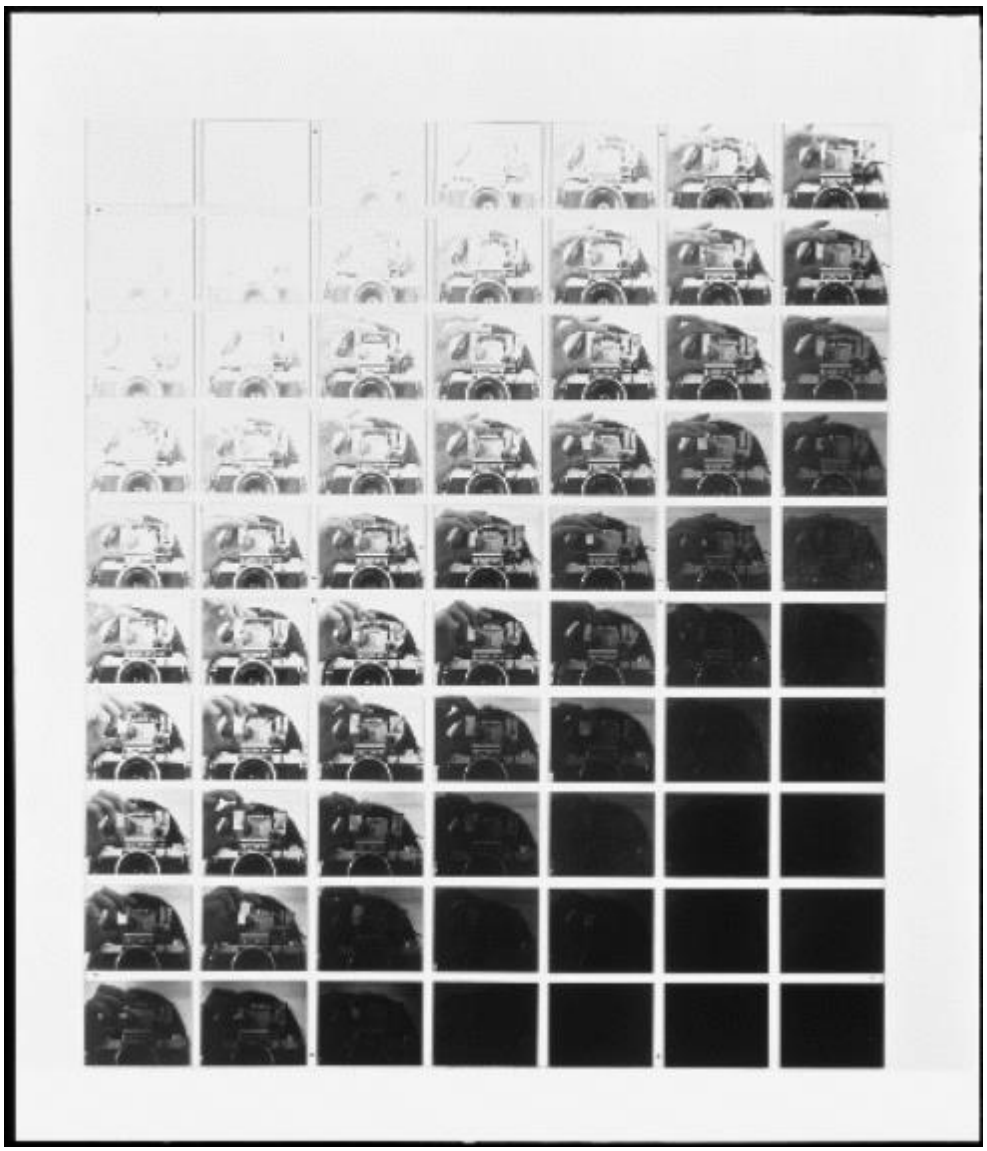

Figure 12. John Hilliard, *A Camera Recording Its Own Condition (7 apertures, 10 speeds, 2 mirrors)*, 1971.

There is a media ecology around the camera apparatus that is built with multiscalar interactions connected through each other, 'compiled layer on layer' (ibid 56). It is a system-based description of dynamic changes, nested within each other; an interpretation over multiple orders and scales.

Like the changes that occur within the sea, the interior of Flusser's apparatus is also, to a degree, 'impenetrable'. The exterior, its connections, entanglements and dependencies cannot be compiled exhaustively.

The telematic apparatus shows change or variation, but is the apparatus itself static (and it is surely a field, or domain, of emergence, like the sea)? Does the apparatus itself change, or merely the settings and adjustments? If the apparatus, were to change (or the parts of it... its industrial production, its educational framework, its aftersales value), how would the envelope of possible images change, and what would that show us? As presented, this set of arrangements are presented at a given time, with assumptions that the images they make can be dark or light according to settings of the apparatus, but the apparatus itself is not questioned.

To focus this question we must ask how we could see the intensive emergence and collapse of the apparatus *itself* and not just the traces it produces. How can the apparatus show more than its possibilities at any one moment, and demonstrate its own emergence and collapse? In later chapters, I will look at Tacita Dean's artworks that address the possibility of their own collapse and the collapse of the processes that allow them to continue. I will also develop my own artworks that deal with this theme.

But returning to the comparison of different understandings of apparatus, Flusser's notions do have some very relevant and useful aspects. The post-humanism shown here is rooted in society and technology. It recognises some of the conditions of the subject that produces knowledge (here the complex that exists around the camera including operator, instrument and many industries). And so it moves beyond human agency as the only actors worthy of consideration. But it only goes as far as to consider human technologies. And while these are non-human in themselves, they are not the radical non-human systems of marine conditions. An ecological post-humanism must address the non-human in wider ways than this. Pushing the awareness of this apparatus into wider systems would also allow us to consider the impact the apparatus has on non-human worlds. It would force a discussion of how the industries of the camera came into being and how they may cease, and the impact they would leave. This widening into the non-human is necessary for the conditions of the anthropocene. The telematic apparatus is not thalassocentric.

Post-human apparatus: Barad

Karen Barad expands upon Foucault’s idea of apparatus to develop what she also terms a 'post-humanist performative account of technoscientific and other

naturalcultural practices.' (Barad, 2007: 32).

This use of the term post-human indicates a move beyond the human centre. It does not propose an augmented, extended human condition, improved in some way by non-human means (for example a technological ‘improvement’), but rather it thinks about the world as if humanity was not in control of the world and its events. It is a different type of post-human apparatus to that of Flusser. Flusser's 'telematic', connected, changing apparatus included the non-human. But its non-human is technology, which derives from social tools and conditions. While not being human, cameras are clearly of-the-human, or from-human. And while connected to and changed by people, seas, animal species and meteorology are much more radically non-human than cameras, or the industries that made them.[xiv]
A telematic apparatus is human and mechanical non-human. It is still driven by the works of people (even if that includes technology) as the key agent. People are still the subject of this apparatus, even if indirectly so through their technologies. However, Barad's post-human treatments consider the entanglement of the social with a different type of non-human (that includes what might otherwise be called 'nature').

Knowledge and the apparatus
Barad discusses forms of knowledge production that are about material things (derived from experimentation and observation of the behaviour of atoms for instance) and also about discursive things (constructed and operated through language and social relations). She does this by looking at how a certain type of 'apparatus' is used in knowledge-making practices (such as, but not limited to laboratory experimentation). Her work shows how it is useful to ask how the apparatus not only defines the conditions that are measured, but actively changes them. Through looking at the apparatus, we begin to see how the observer and observed are 'entangled'.
Disciplinary implications
The entangled relationship between disciplines (between material and discursive disciplines in particular) is of great relevance when considering the role of cultural production in the context of ecological knowledge. Barad's insight into diffractive methodologies is a useful way of seeing how it is not sufficient to allow material knowledge-making practices to remain the only valid way of speaking about

ecological change. The role of cultural knowledge then cannot be to merely communicate, or illustrate objective facts produced within other disciplinary practices. Material knowledge must be influenced (diffracted) by discourse, as much as discourse is diffracted by material knowledge.

We can look again to Barad's reading of Foucault to see that discourse is more than words, symbols or language. We need to avoid the 'mistake of representationist thinking.' Discourse isn't the fact of language, but the possibilities and understandings it constructs and makes possible: 'that which constrains and enables what can be said' (Barad, 2007: 146)

Barad discusses the boundary of the apparatus as a way of considering the discursive construction of the processes that lead to knowledge:

> 'Is the outside boundary of an apparatus coincident with the visual terminus of the instrumentation? What if an infrared interface (ie a wireless connection) exists between the measuring instrument and a computer that collects data? Does the apparatus include the computer? Is the printer attached to the computer part of the apparatus? Is the paper that is fed into the printer? Is the person who feeds the paper? How about the person who reads the marks on the paper? Or the scientist and technicians who design, build, and run the experiment? How about the community of scientists who judge the significance of the experiment and indicate their support or lack of support for future funding? What precisely constitutes the limits of apparatus that gives meaning to certain concepts at the exclusion of others?' (ibid: 142-3).

This widened apparatus was seen to some extent in Flusser, above. But here, the apparatus need not stay within human production. It includes non-human materiality such as atoms, or for that matter other environmental conditions. Instead of maintaining the human as a central point acting in a world that yields its secret, a post-human apparatus shows an accumulation of intermediaries; each of which is capable of acting in some way. Here we have an approach that is material, social, objective and also about discourse.

As we have seen, environmental change is diffuse and difficult to know. It requires equipment that extends our perceptions in time and space and opens up views on

more complex processes and distributed phenomena taking place on different scales of complexity; what Morton (2014) calls hyperobjects. These hyperobjects – similar in many ways to the distributed entanglements described by Barad – may be widespread and elusive, but they can be rendered visible, when interacting with our tools. Morton observes that "what we see is glued to the equipment that sees it". (Morton, 2014: 37). This ‘sticking’ is a form of connection and reconfiguration from environment to the social, realised through an extended apparatus. The apparatus that is described by Barad is suitable for this operation.

Summary

The apparatus is an axis that – according to Latour, Shapin and Schaffer, Foucault, Flusser and Barad – is key to the constitution of different forms of knowledge. The types of apparatus described are not identical, nor is the knowledge they produce.

The scientific apparatus is presented as a producer of objective facts, able to reach beyond the limits of human senses into further reaches and more elusive realms. This model of apparatus would assist when addressing the elusive sea. But I have shown that science has social foundations and societal impacts that are ignored in this type of apparatus. Looking at our place in the ecological, changing sea of the anthropocene is not possible with science alone. I have shown how the industrial, polluting, complex connections of people and their processes are part of the anthropocene and so part of the thalassocentric conditions of the sea.

Foucault's apparatus is social but not non-human enough. Other post-human apparatuses are also not sufficiently engaged with the non-human. Barad however, does not focus on a specific instrument, but considers how any instrument may connect with the material world and also help to construct discourse. This is a very helpful model of apparatus.

The next stage of diffraction

Following this comparison of different types of apparatus, my progressive testing and refining of artworks can move a step towards including the subject in some way but also talking of the non-human.

It is clear that in the anthropocene and with the case of the sea, the *enquiring*

subject matters. The subject makes an impact on what is looked at (whether by making ripples as when swimming, or by contributing to different types of environmental degradation). So the subject that makes the artwork, ie the apparatus, must be visible.

But the apparatus, and the research that follows, must address more than the social conditions that support the investigation. Subjects must address more than themselves. Social conditions are connected like the sea and they change like the sea. But society alone is not the issue. The anthropocene may be derived from particular power relations and types of subjectivities, but its impacts are also on the atmosphere and food chains, and levels of pollution, as well as human societies and individuals. The shapes of complex movement in these non-human systems are relevant to this research.

Complex movements and shapes were *hinted at* within the sea swimming drawings that I undertook initially. But these types of movements and change were only suggestions. They were not backed up with any knowledge of material processes, other than an intuitive sense of change that came from experiencing an environment. So I must now look more carefully at complex changes seen in materials.

These are very large conditions to be addressing, as I have already mentioned. But this comparison has helped select the key point, and focus *where*, or *how* the thalassocentric apparatus must work. The point where social and non-human conditions entangle need not be such a large space. The apparatus can be quite small and modest. All that the thalassocentric apparatus needs to do is to connect and make visible types of complex material change (in ways that are relevant to ecology and the sea) while showing the processes and subjectivities that support the apparatus.

Chapter 4 Change in Complex Systems

I have looked at different understandings of apparatus. It is now clear that the thalassocentric apparatus necessary for this research would in some way assemble, register or make visible multiple types of knowledge. It would show changing material arrangements in the sea and beyond. It would also engage with social and cultural conditions in multiple ways and it would present or register those engagements in some way.

I have shown how the complex entanglements of apparatus involve tools and processes which look at the world (as science does for instance). And the apparatus is configured by the world (as where social conditions support or allow tools or processes making up the apparatus). Both directions of change act upon each other.

While I am using the concept of apparatus to describe connected and changing phenomena on different scales, it could still be clearer exactly what sort of change the artistic, thalassocentric apparatus might be able to register. I have drawn attention to some of the conditions of the sea (wave shapes, chemical composition of the sea, plant and animal populations, economic systems dependent upon the sea). The exercise of sea swimming and drawing has lead to visualisations that could conceivably relate to intensive changes such as these. These types of change involve multiple events acting in unpredictable ways. They are, as discussed above, complex. So the changes that a thalassocentric apparatus should be able to register should be complex too. The drawings suggested emergent properties, which developed within the drawing process, at times appearing to grow and collapse in a way that matched some of the movement of the sea. But as discussed, these drawings were not able to 'connect' with or show material conditions well enough to be carried further forward in this research. They suggested complexities that might be from marine or ecological systems, but were not clearly produced by them. They

lacked a degree of credibility that would relate these types of movement to material change.

Complex systems can be engaged with by apparatuses though, including artistic ones. And considering the elusive nature of much change that takes place in the sea, it is timely to test a different, more directly-material approach using other things besides the sea. In this chapter I discuss an artwork that does this and I will compare complex change of two sorts – complex changes in the shapes that a material presents and complex changes in the 'shape' of ecologies – to see how an artwork might show these. The aim here is to understand what an artwork could show, and also consider how far this understanding might be extended. If an artwork shows complex changes in one material, does this help us understand complex changes in other things? So the next artwork addresses the behaviour of sand and it diffracts learning from the artwork against knowledge of complex systems.

I will seek to describe this artwork in ways that make sense in a number of fields, appropriate to this research context. I do this by increasingly moving from the specific to the more general before returning to reconsider artworks again.

So after describing the matter from which the artwork is constructed (piles of sand), I use the theory of Jane Bennett to highlight how that material can be thought of as having its own form of agency (or vibrancy). I then describe the artwork and how it shows the movement or agency of sand in particular ways that are relevant to other systems of the anthropocene. This helpfully introduces the more 'general' ecological theory of Panarchy which describes creative and dynamic change that involves emergence and collapse as a type of wave in different material systems. The theoretical wave shapes described by Panarchy are applied to what I can now call intensive change, but they occur in very different materials and many different systems. The theory also describes how this change can move or cascade from one scale to another. It is very appropriate given my earlier description of the problem of the sea then.

After looking at these cultural and ecological theories about the behaviour of materials, I return to reconsider the artwork again (and briefly the drawings discussed in the previous chapter). Reading the artwork against the theories of

material change affects both types of knowledge and results in an understanding of how the materials that make up an artwork can be thought of as undergoing complex change. This affords new insight which helps reconsider the artwork as apparatus and leads to a concluding discussion of the artworks' own impact or footprint.

Sandpiles

The work was centred around the complex and unpredictable balance point ('criticality') that occurs when a pile of sand is built up higher and higher, until it is on the point of collapse. The movement of sand in this artwork was not determined in any way by the movement of oceans, but *how* and *when* sand collapses shares similarity with other types of collapse in other types of system.

Fig 13. The resilience of the sandpile (whether it is stable or precariously balanced) could be thought of as an intensive property and the sand then becomes a way of observing complex intensive change.

The theoretical physicist Per Bak, who researched the movement of sandpiles as a model for complex behaviour says that 'The behaviour of the critical sandpile mimics several phenomena observed across many sciences, which are associated with complexity' (Bak, 1999: 3), and he includes earthquakes, mass extinction and stock market crashes as relevant examples (ibid: 14-17). Sandpile models are also recognised as relevant to ecologists. They show the growth or structuring of natural resources, ie they 'capture recurrent build up, release, and renewal phenomena'

also found in ecological cycles, according to theoreticians of ecology (Yorque et al, 2002: 425).

A pile of sand on the point of collapse is said to be in a 'critical' state. A mini avalanche of sand forms a dynamic of its own, which 'can be understood only from a holistic description of the properties of the entire pile rather than from a reductionist description of individual grains: the sandpile is a complex system.' (Bak 1999: 2). The precarity and uncertain collapse that is modelled by sandpiles is relevant in terms of multiple systems that may collapse in complex ways then.

Given that a thalassocentric perspective emerges from within the sea, but the connections and changes it address go beyond the bounds of the sea, the lessons offered by the movement of sand, and its collapse, are relevant. In one way, the use of a very accessible and easy to consider material like sand might be thought of as a metaphorical test which could then be considered or applied to other circumstances. But at the same time, the movement presented by sand - its complex intensive change – is not a metaphor. It does not stand in for something else that it is not. In intensive terms, the sandpile shows the *same thing* as the complex intensive change found in other materials and systems. This comparison of behaviours in disparate materials is recognised by cultural theorists too and it is helpful to reinforce the cultural significance of this shared intensive movement. I will turn to the work of Jane Bennett to do that.

Sand as Vibrant Matter

Equating complex emergent behaviours found in disparate conditions (such as the sea, ecologies, societies and material systems like sand) has some similarities to Jane Bennett's concept of *Vibrant Materialism*. Bennett tries 'To give voice to a vitality intrinsic to materiality, in the process absolving matter form its long history of attachment to automatism or mechanism' (Bennett, 2010: 3). Her *Vibrant Materiality* supports the idea that the way sand behaves may be like the way other conditions in the world behave.

Bennett draws comparison between very different conditions too; such as the organisation of chemical systems described by Manuel De Landa and the movements, changes and characteristics in the novelist Kafka's human characters. For her, both chemicals and fictional characters display emergent properties that are

derived from the vital materiality of the matter from which they are made (ibid: 11).

She describes this ability using the phrase *Thing-power* which owes much to the work of Latour, De Landa and Deleuze and Guattari, that I will discuss in chapter 6. The materials she deals with are viewed as actants (ibid: 3), a term developed by Latour. But these things are also in us, or made of us; 'Human being and thinghood overlap' (ibid: 4).

Similar to my aim of developing a thalassocentric perspective, vibrant materialism seeks to understand distributed, or connected, agency as opposed to an atomised view of the non-human world. Bennett does this by looking at different examples of matter, including among other things electricity, metal, worms and stem cells. And scientists such as Bak see similarities between the way sand collapses and the way economies, species and geologies collapse. So an artistic use of sand has some basis for talking about complex change such as that around the sea[xv]. Bennett has also made the comparisons and diffractions that I am undertaking here, though in different locations and to different ends. The use of this short introduction of her work is to reinforce the similarity of the changes I am discussing.

Describing the Artwork

The work I discuss here was entitled *Sandpile – Regret over Intention* (2013), (Graded, sterilised Cornish sand, table, glass, lights, paper, spoon, 60w energy). It took the form of an interactive sculptural installation, which used materials taken from the local beach environment to model complex conditions.

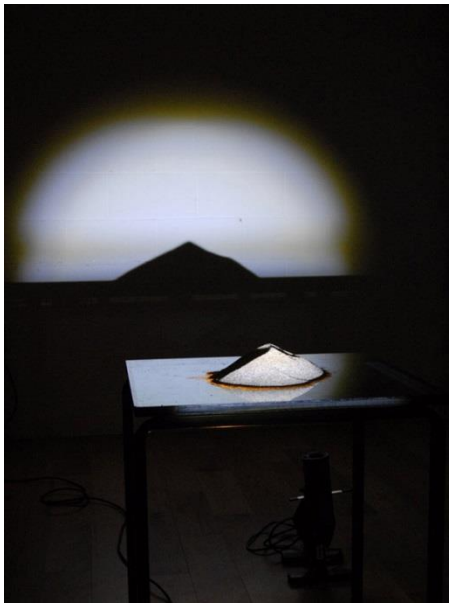

Fig 14. Sandpile – Regret over Intention (2013). Shadow cast onto wall

A table, laden with sand, was presented along with spoons and further reserves of sand, inviting participants to scoop up and play with the heap in the middle. The work was lit with two lamps. One (directly in front) cast a shadow, or peak-like curve on the wall, the other
(from below) cast a dark cloud onto the ceiling.

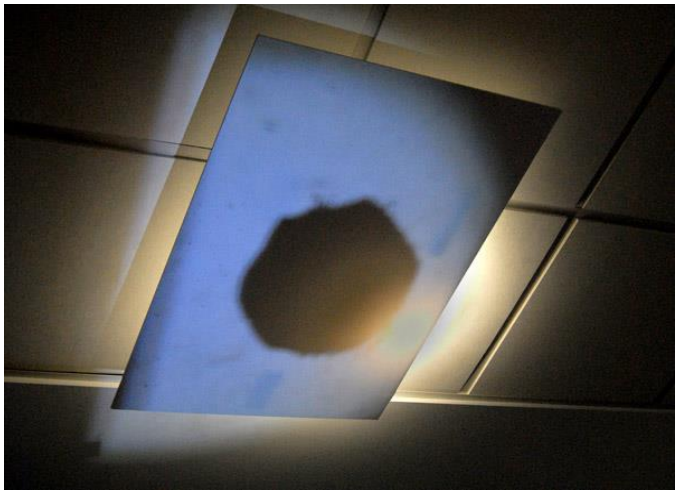

Fig 15. Sandpile – Regret over Intention (2013). Shadow cast onto ceiling from same sand

These shadow images and the title of the work suggested planned metrics (such as growth) and ominous looming impact. People viewing the work were encouraged to

change the arrangement of the sand and so maximise the peak on the graph, while minimising the area of shadow it casts as impact. It became clear that it is possible to increase the height of the planned *intentional* peaks without increasing the footprint of *regret* up until an unpredictable point whereupon cascades of sand spread and increase *regret* as the peak collapses.

A quote from a seminal paper (Lewin, 1999) explaining this use of sand piles was given alongside the work (as below).

> ‘In order to visualize a physical system expected to exhibit self-organized criticality, consider a pile of sand. If the slope is too large, the pile is far from equilibrium, and the pile will collapse’ (Bak, Tang and Wiesenfeld, 1987: 381). This emergent process of 'self-organized criticality', balancing growth and collapse is also present in other complex systems such as economy and ecology, although it is not modelled or measurable in exactly the same way.

The work demonstrated a tension between growth and collapse of the pile's structure. The unpredictable point at which growth changes to collapse is shown by the sand and this model is used by theoretical physicists who want to look at critical conditions of unpredictability. The quote referenced a way of understanding stability and collapse in dynamic systems. Dynamic stability was suggested as relevant to other systems (including economics and ecology). It did not propose the sandpile model as providing exact measurement of economy or ecology.

Growth and collapse modelled by sand

As presented in this work, the *critical stability* of sand shows the agency of non-human systems. We may try and control or build them up, but they will do what they want in the end. This uncertainty questions the pre-eminence of human control or planning. The work draws on both scientific and cultural perspectives (of Bak and Bennett respectively). Any assumption that the pile can be indefinitely raised up is met by a demonstration of the limits of its own growth (the pile collapses, its footprint grows. As a result the sides of the growth shadow cast on the wall become less steep and the looming cloud grows wider over the whole apparatus). The pile and its own preferred state of self-organized criticality assert themselves. Also, the point at which this collapse commences is impossible to predetermine exactly. Complex

change is shown to be unpredictable. The work shows the behaviour of sand piles as relevant to the behaviour of other systems.

The central idea the work addressed is of the precarious and uncertain interconnection between growth and collapse. It showed these two conditions as linked within one complex material process.

Diffractive Reading: Waves of Collapse in Complex Environments

I will now consider how this interpretation of dynamic material agency can be seen in other changing systems. To do that I will look at a further theory that deals with types of change and processes of connection at different scales of ecology. How clearly can the movements shown in the sandpile work be applied to ecologies? To answer this, I will use the ecological theory of Panarchy.

I will describe why this theory is appropriate. It is 'general' and has been applied to a range of different systems in ecology and society. It is described using wave shapes, which is also relevant to the sea-based perception from which this thesis starts. It shows the importance of emergence and collapse, which is relevant to a number of ideas through this thesis, not least creative processes itself (which I will discuss further in parts 2 and 3 of the thesis) but also philosophical ideas about change and ways of understanding the precarious conditions of the anthropocene. And it describes changes that happen and communicate through different scales in a clear and useful way.

Following this discussion of the theory, I will return to the artwork and reconsider it. Using Barad's method both the theory of Panarchy and the artwork it interferes with will have changed.

Ecological theory of Panarchy

Ecological theory considers the material world, including complex systems involving living organisms and their surroundings. In an attempt to describe processes of transformation in human and natural systems Holling and Gunderson developed an interdisciplinary and cross-scale dynamic model ‘Panarchy’. This name is coined to suggest the antithesis of *hierarchy* (which literally means sacred rules) and instead inserts a reference to the Greek god of nature and chaos, Pan (Holling, Gunderson

and Ludwig, 2001: 21). So it is a description of natural and chaotic change. Instead of being shaped by top down forces, Panarchy addresses change occurring across many levels and scales.

Panarchy as a simple and general methodology

The model of Panarchy (or 'metaphor[xvi]' as they term it (ibid: 33)) is developed to describe ecological dynamics in habitats of a range of scales, as well as the history of human populations and the behaviour of social systems like bureaucracies and industries (ibid: 55). Again, as with Bak and Bennett, this is a model that seeks to describe common movement in different changing systems. It is proposed as a tool for policy makers and environmental managers as well as those concerned with business organisation and cultural practices (Burkes and Folke, 2001). It is a helpful way of attempting to extend the insights from works such as the sandpile (and to some degree the sea-swimming drawings that preceded them).

The metaphor of Panarchy describes and names changing *stages* within complex systems. Some of these stages are already established in ecological theory while others are new to this theory. For instance *exploitation* and *conservation* are established concepts in ecosystem theories, describing stages where organisms compete to acquire and then accumulate 'potential' (Gunderson, Holling, 2002: 33). These types of change can be compared to the build up of sand in the sandpile and perhaps to the swelling, growing patterns in the drawings discussed previously. To these existing theoretical stages Panarchy adds *release* and *reorganisation*, which can describe collapse and renewal (and so collapse in sand and collapse of a pattern in the drawings). A picture is constructed that includes rapid, diverse growth and changes: Opportunity becomes embedded for the strong and successful (whether they be social strategies or species). This is displaced by disruption and then collapse and renewed opportunity can follow. The whole process exhibits a wave-like shape which the authors demonstrate with a drawing.

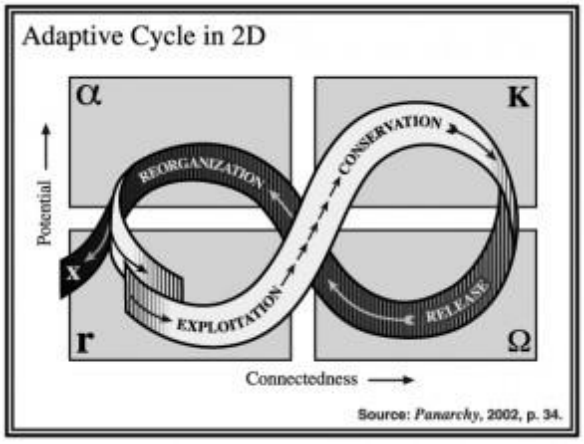

Figure 16. The Panarchy adaptive cycle: a 'stylized representation of the four ecosystem functions (r, K , Ω, α) and the flow of events among them' from Gunderson and Holling, 2002: 34.

An ecological wave shape in conceptual space

The process from accumulation and collapse to reorganisation is a notable aspect of the Panarchy metaphor. We see a model of change that has a wave-like structure, growing, teetering at a point of maximum potential, then collapsing, only to reorganise and start to grow again (maybe in a different way or scale). The metaphor seeks to visualise the behaviour of many complex systems – whether human or non-human – and find a type of intensive movement that is 'at least as interesting philosophically as it is ecologically' (ibid: 35). It is a new disciplinary perspective that strengthens the idea of wave-like growth and collapse in many different, connected systems. This has relevance for changing environments and it describes resilience as an oscillating process of balance.

There are two opposing forces that lead to this figure of dynamic, oscillating stability and they are relevant for this thesis. The balance of Panarchy pits emergent organisation against collapse. Both halves of this wave play their part. 'On the one hand, destabilizing forces are important in maintaining diversity, resilience, and opportunity. On the other hand, stabilizing forces are important in maintaining productivity and biogeochemical cycles' (ibid: 26). This is a figure which is dynamic, creative and involves two behaviours interacting continually. It is relevant to ecology, to creative practices such as art and to other theories I will engage with during this research. A similar two-part dynamism is also found below in the system of thought of Deleuze and Guattari (as deterritorialization and reterritorialization), and I will

return to it later to further contribute to this understanding of the wave-like movements of thalassocentric change.

Collapse or resilience of systems

The cycles of Panarchy describe the accumulation and release in 'potential' (ie resources), such as biomass and nutrients in biology. But it is also applied within economics and social organisation, to market share, or expertise among companies (ibid: 34-35). The complete metaphor and its stages provide a moving, dynamic image of connectedness in complex systems. It also describes how mature, well-resourced systems can become less resilient, especially if they become highly dependent upon fixed conditions or ways of working. So this theory applies wave shapes to intensive qualities in various complex systems in order to describe how they persist or become fragile and collapse.

Just what is growing and shrinking in Panarchies? It is not necessarily individual material objects (animals and plants...). Often it is aggregate properties such as population *size* or even a conception of fitness, or the idea of potential (involving accumulated energy, nutrients, social capital or other intensive resources). It is a model that is expressed through diagrammatic shapes of change. It is developed through waveforms, and it is applicable to natural systems and human ones. We see a description of connected change that suggests waves of emergence and collapse taking place in systems such as sandpiles, or larger natural or social systems. The most obvious of those is clearly the structural stability of the sand. In some way, the material agency of the sand is acting diagrammatically to show us what Yorque calls a 'disturbance panorama' (ibid: 432). But this figure of change is not standing-in for something that it is not. The complex intensive changes in sandpiles share movement with other systems. Species are not sand. There is metaphorical comparison underlying this modelling, but the work of Bak, Gunderson and Holling show us that types of intensive change share similarities in apparently different conditions. There is some type of shared systematic behaviour. As well as being relevant for ecology, creative arts practice and the shapes found in the sea, it is relevant to the impacts of sustainable living. It is a model of change that could be applied to thinking about how crisis leads to collapse.

Nested change: cascading collapse

Having looked at the dynamic, complex, sometimes creative, sometimes destructive movements described by Panarchy and initially considered how they share similarities with movements shown in sand, I now discuss how these movements connect over multiple scales.

Panarchy is a theory that does not look at cycles of events at one scale only; isolated from the contexts that produce or inhibit them. The model looks at how the behaviour of one cycle (for instance at leaf scale) can influence other cycles at different scales (for instance within a whole tree, a patch of trees or a forest (ibid: 87)). And Panarchies are identified in human history, with waves of innovation bringing about transformation and disruption in different, connected realms. Randomly distributed events (termed 'stochastic') external to a cycle can trigger spasmodic collapses, especially when they 'encounter vulnerabilities' at another level of the whole nested system (ibid 91). Changes can be creative or destructive. 'Productive novelty can cascade up the levels, or ...destructive catastrophes cascade down' (ibid: 88).

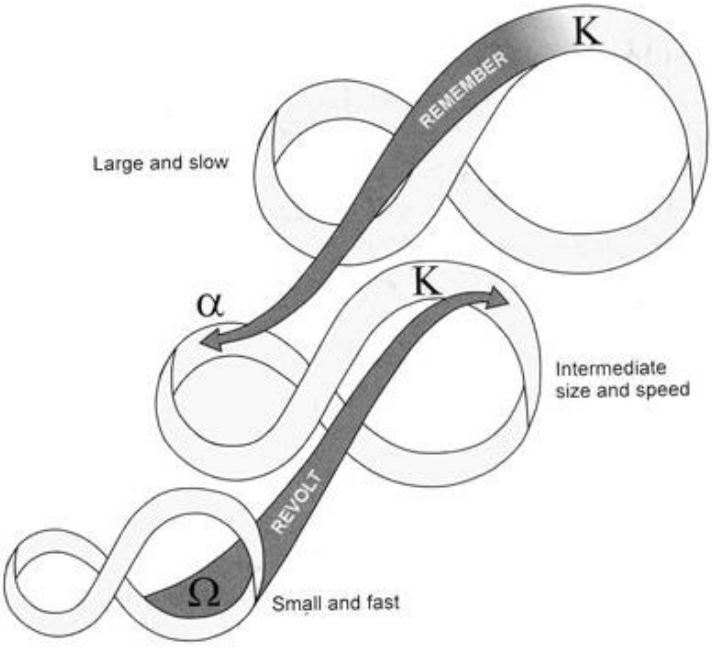

Figure 17. 'Panarchical connections' (Holling, Gunderson and Peterson, in Gunderson and Holling 2002: 75). This model is applied to a range of multi-scale fields including institutions and their rules; economies and the preferences of individuals, institutions and markets; nations and their markets, governance and

> infrastructure and for knowledge systems including local knowledge, management practices and worldviews (ibid 75).

When a local system goes through a collapse stage, that collapse can add to wider instability if the larger system it belongs to is in a precarious state. Effects can pass to the next scale.[xvii] This is a shape of change that repeats over different scales. To some degree this could be said to be 'fractal'. I will describe the use of this term more thoroughly now.

Fractal

Fractal geometry describes structures that replicate over many scales. They are self-similar in that shapes are repeated at smaller or larger scales (https://classes.yale.edu/fractals/). In a strict, mathematical sense fractals are infinite. Waveforms interacting and building over different scales exhibit a degree of fractal structure, though clearly this is not infinite. The more complex structures of panarchies are also nested waveforms of change, with some fractal characteristics. Previously we saw that Flusser's idea of an apparatus was complex, and existed on many levels, and that you could not arrive at the 'bottom' of it. Again this describes fractal structure.

So fractal structures are found in apparatuses, in waves of water and in waves of changing environmental ecologies. These are material structures, that might be studied by natural sciences. This is a type of structure, common to complex systems, that applies to many of the examples I am looking at, including Panarchy.

Reconsidering the Artworks

So the changes and wave shapes described by Panarchy can be applied to many systems. The theory constructs a type of intensive conceptual space within which wave shapes move and communicate. Change involves emergence and collapse, both of which are part of the creative dynamism that the idea describes. Change moves between different scales and occurs in different systems.

The movement, life and vibrancy of this theory shares something with the ideas of Bennett, but it also adds a visual element, and when diffracted against the research I have undertaken so far about the movements of the sea, this knowledge presents

a sense of the *way* that changes move.

The resilience within a Panarchy is clearly relevant for a reading of the sandpile artwork (does the pile tip over?). But the way the theory deals with connections between scales can help address something of the hidden dependencies within systems such as artworks. Small changes can cascade. Collapse can lead to further, greater collapse, if a fragile system depends upon an underlying system that is also fragile. Moving from scale to scale helps the reading of artworks.

Interpreting the previous sea drawings in the light of figures of change that Panarchy describes, we can read patterns emerging across the crests of multiple waves (as they do when moving from nesting site, to local bird population, then species).

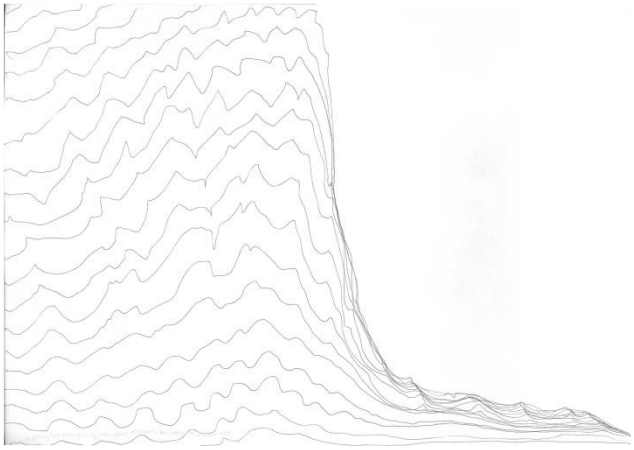

Figure 18. Sea Swimming Drawings can be revisited in the light of Panarchy. Waves of intensive change, perceived at many parts of a connected system can share behaviours.

At sea, ripples sit within a deeper swell and in fact contribute to and change that swell in unpredictable patterns. This is a similar type of movement seen again; a picture of complex systems that move in thalassocentric ways. The systems described include non-human ecosystems, but also human and social ones. The ecological relevance of this picture is strong and its modelling of collapse offers a powerful insight into precarious conditions, whether they are societal, economic or environmental.

Can this expanded sense of scale apply to the sandpile work too? Initially this is not

so clear. The material system under consideration is apparently tidily bounded. If the table on which the sand were sitting was also on the point of collapse, this might be the case, but as it is, the work's scale is between a few centimetres to half a metre or so. Anything larger or wider than that appears metaphorical.

So now the work can be considered as a material apparatus that depends upon numerous systems in order to have been produced, and its apparent bounds change. If we were to consider sand as the only visible part of the artwork, this would perpetuate a scientific understanding of apparatus, which intentionally makes the enquiring subject invisible (as discussed previously). The artistic apparatus is a collection of varied materials, including a table, lights and power, but also the room in which it is sited and the institutional context that allows the production and display of the work. These are material systems of a different scale. The apparatus is as much power socket as it is sand. It exists in multiple spaces that are more or less visible in different perspectives.

So the work also contributes to and affects social, intellectual and material systems of larger scales. Like the waves of a Panarchy, the small scale acts of this work depend upon larger cycles of emergence and collapse. And it may conceivably affect those processes if they are in a state that is receptive to change. Those cycles of change could be in ideas, or they could be in the infrastructures that produced the artwork (its material footprint). If the institution that produced this work were in a precarious situation with its finances or reputation for instance, the investment and disruption of even a small artwork could tip larger systems into crisis (be that a course, a department or other systems of wider scale). For this work, considering wider scales of change involves the question of how artistic apparatuses differ to scientific ones.

Applying the ideas of Panarchy to this work shows us that given the right conditions, a simple artwork could trigger change that is much wider. And following Bennett's understanding, these changes are vibrant and material. In other words, it is possible that the type of intensive changes that cascade from an artwork through social and psychological life share, in some way, the types of movement of a sandpile, and the sandpile shares the types of movement of ecological and economic systems. These vibrant systems are connected. They can grow, become precarious and cascade

through changes of collapse. So to conclude this chapter I look at some ways of considering the wider systems this art apparatus was part of.

Including the Apparatus

Previously I discussed how the elusive nature of knowledge about the sea often calls for very large and resource-hungry forms of apparatus. This is one obvious criticism of certain types of marine apparatuses that are deployed in the sea for sustainable aims (such as research vessels and other open sea installations). If we are to acknowledge the role of an apparatus as an agent for change in the environment in which it operates, then we might wish to reduce the impact of that apparatus, in order to make both the environment and the apparatus as resilient as possible. This approach is also helpful for artworks of even the smallest scale and it starts to make the material aspects of the apparatus more visible.

There is a pressure from managers of arts programmes concerned with environmental sustainability, to reduce the impact of the arts 'industry' (in other words the larger scale material and social practices of art apparatuses).

Julie's Bicycle is an arts organisation that leads the work with theatres, festivals, galleries and other sectors to measure and reduce the greenhouse gas emissions of the arts. Their response to support the arts to reduce their emissions is to:

> ‘UNDERSTAND your environmental impacts; PREPARE for compliancy (sic); REDUCE carbon emissions; SAVE money; SHARE the story; BUILD your brand; JOIN a community of companies working together to green the industry.’
> (Julie's Bicycle)

This practical approach can be a helpful starting point for making the hidden parts of the art apparatus more visible. This was attempted for the work *Sandpile – Regret over Intention.* The degree to which this was successful is not clear, since the boundary or extent of the apparatus was seen to continue through many realms and substrates. However, the exercise was useful for future stages of the research. As in the problem of the sea (discussed in Chapter 1), the boundary of the apparatus is indeterminate and the edge of its environmental impact may be equally hard to determine.

In this work I was able to list its impact in some limited ways. I attempted to demonstrate how the work's own production and presentation was implicated in wider industrial and economic processes that contribute to unsustainable conditions.

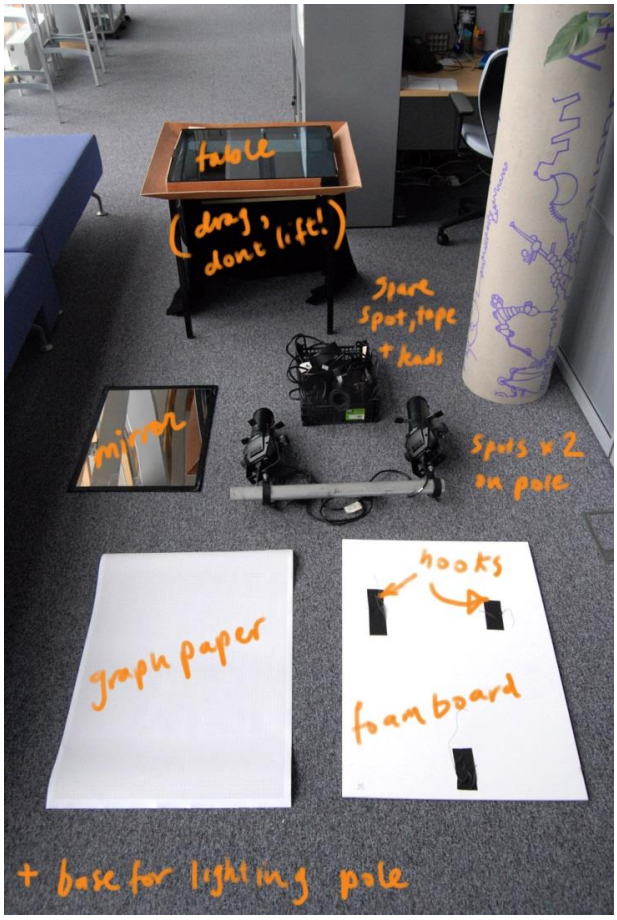

Fig 19. Equipment required for the installation. As well as the materials and lights, the work requires continual mains power.

The materials that comprise the work were listed as including 60W energy to power the lights casting shadows. This energy load (and other equipment listed) starts to point towards processes of construction, service and powering, that are part of the work. The work was presented in a room entitled 'the sandpit' an innovation hub contributing to the university's growth strategy (Falmouth University Corporate Plan, 2014), during an exhibition event about climate change. The work was titled and its materials described in this way to draw attention to this relationship. The multiple systems of emergence and collapse to which the work might relate arguably include those of the anthropocene at the largest scale (the work had a carbon footprint). But at a medium scale, economic development and the resource use of institutions are

also included. The scales of change which an art apparatus disturbs are indicated, however obliquely. These connections emerged tangentially from the artwork and might have been more forcefully made for those viewing the work in situ, but it is when it is read diffractively as a way of progressing this research, that *Sandpile - Regret Over Intention* produces clear findings. Subsequent works attempt to consolidate and present the connections suggested here in different and more satisfactory ways. Showing the materials that comprise the work, and the processes that allow the work to be staged help trace complex material connections which the work may change.

Reading the metaphor of Panarchy against the artwork supports a discussion of different scales and different realms of relevance. The artwork can be seen to increases the load of our current unsustainable energy use in some small way. It draws attention to its own conditions and materials as part of the work. In these terms, the artwork itself sits on top of a conceptual sand pile, an apparatus in the terms described by Beech or Foucault in previous chapters.

Summary

Having discussed Panarchy and the vibrancy of materials such as sand, the context of this research is also clearer. Emergence and collapse in material conditions (even on a small, table-top scale) are able to say something about emergence and collapse on wider scales, including the widest scales of long-term resilience in socio-economic systems and large collections of species. Similar ways of change (often wave-like) are observed in apparently disparate conditions. More accurately these ways of changing are observed in the conceptual spaces in which we understand these systems. Artworks and other apparatuses can help to present these intensive changes. They can also show or consider their own material footprint. The theories of Bennett start to show that the art apparatus itself has a vibrancy like that of other material conditions. The work attempted to display connections between the extensive material movement of sand and intensive waves of change in social, environmental and economic conditions. The artwork itself moves in vibrant ways, and has the potential to show waves of emergence and collapse. These were not fully realised by this work, but the work did show that this was possible. The next chapter will describe a work that addresses the changes in the art apparatus more directly.

Chapter 5 Making an Artistic Apparatus Visible

Introduction

I have tested and progressed my examples of art practice and ecological and cultural theory, using one to modify and improve the other in turn for the purpose of my aims.

I initially assembled a range of disciplinary perspectives to understand the potential breadth of the changes taking place in and around the sea. These could be complex and elusive. Comparison of different theories of apparatus led to the adoption of a particular post-human idea of apparatus that was attuned to entanglements along its length.

Drawings were able to show, or more accurately suggest, some of the behaviours of connection and change that occur around the sea, but not in a very credible way. They did function to reflect the very subjective experience of being in the sea, filtered through a body of experience that included training, research and other influences that were more or less perceptible to me, the artist, but not particularly visible within the artwork.

In an attempt to produce a work that had a stronger connection with material processes of change, but still reflected some of the rich and multi-layered types of change that occurred in the sea, I produced a work about the collapse of structures in sand. Interpreted alongside theories of vibrant materiality and also of complex behaviour in ecologies, this sandpile artwork showed a process of dynamic and complex balance that could also relate to movements in other systems, such as economies and ecologies. Considering these different examples from an intensive standpoint, the movements and changes in the drawings made more sense again. The work also showed something of the uncertain (stochastic) change that could be said to characterise conditions of systems in crisis.

Attention was drawn to the process of making the work and this highlighted how the work was part of a larger apparatus of knowledge production (including for instance, the university). But this could be more visible still. The marine aspect of the work was minimal although the aim of this research (developing apparatuses that can describe thalassocentric conditions) is not specifically about describing the marine, but rather learning from it with the potential to applying marine perspectives elsewhere.

The following artwork is the last in this first section of the thesis of tests which use their findings and failures to establish methodology and context for the latter parts of the thesis.

This artwork – a performative piece which used sound – attempted to address its own conditions of production more directly than the sandpile work described above. This it did manage, at the same time as showing conditions that pertain to the sea. However, as I will see, there remained a form of disjunction between the two halves of the work.

Describing the Artwork

I presented a performance that would talk about combined waves of different scale. It looked at the waves that occurred in the sea and also those that might be considered as waves of development and collapse that constituted the various parts of the apparatus that was performing. By this, I attemtped to draw into visibility the equipment that I was using, which included technical machines of one sort or another, and also to make visible the industrial processes that produced those machines. In the context of the anthropocene and while attempting to 'Understand your environmental impacts' (as Julie's Bicycle put it), the question of which processes an apparatus draws on and is implicated in becomes relevant. As I have shown through my investigation of types of apparatus, this question is also very difficult to settle definitively. An apparatus might use energy and resources itself, but it is part of wider flows and trends of unsustainability. How the equipment I used relates to wider apparatuses of industrial manufacture, shipping, pollution and waste is not a question that can readily result in a quantitative answer. But using the findings from previous artworks and their diffraction against other types of knowledge, it is possible to try and show some of the movements of emergence and

collapse that the equipment may be part of.

The performance was given at the symposium *Performing Site*, Falmouth 2014. The work was entitled: *Material flow and entangled oscillation: The art apparatus and its own production.* The performance attempted to register and present an experience of waves from different systems with which it was entangled. It showed two sorts of wave. The performance was given using a collection of devices described below.

Fig 20. Technical elements of the performance Material flow and entangled oscillation: The art apparatus and its own production. 1: Synthesizer producing a sound. 2: Audio mixer, 3: Bench oscilloscope with visualisation of audible sound – here a sine wave. 4: Camera, and 5 projector producing a live feed of waveform image for audience to view. 6: rock holding down key on synthesizer to make sound. Image: Ethan Folk

Two types of wave – firstly sound

Firstly the work drew attention to one type of wave – a sound wave that was heard and also seen. A continuous tone was generated by a nearly-new Arturia Minibrute synthesizer (see figure 20). This was monitored by a thirty-year old *Leader LBO oscilloscope.* A bench oscilloscope like this can show an input (such as the changing voltage associated with the electronic signal of the synthesizer) as a visual display. In other words it makes a sound visible, showing its characteristics as a

wave, but this remained the same wave, just shown visually rather than heard. The visual trace of this sound was then projected as a moving waveform image on a wall (see fig. 21).

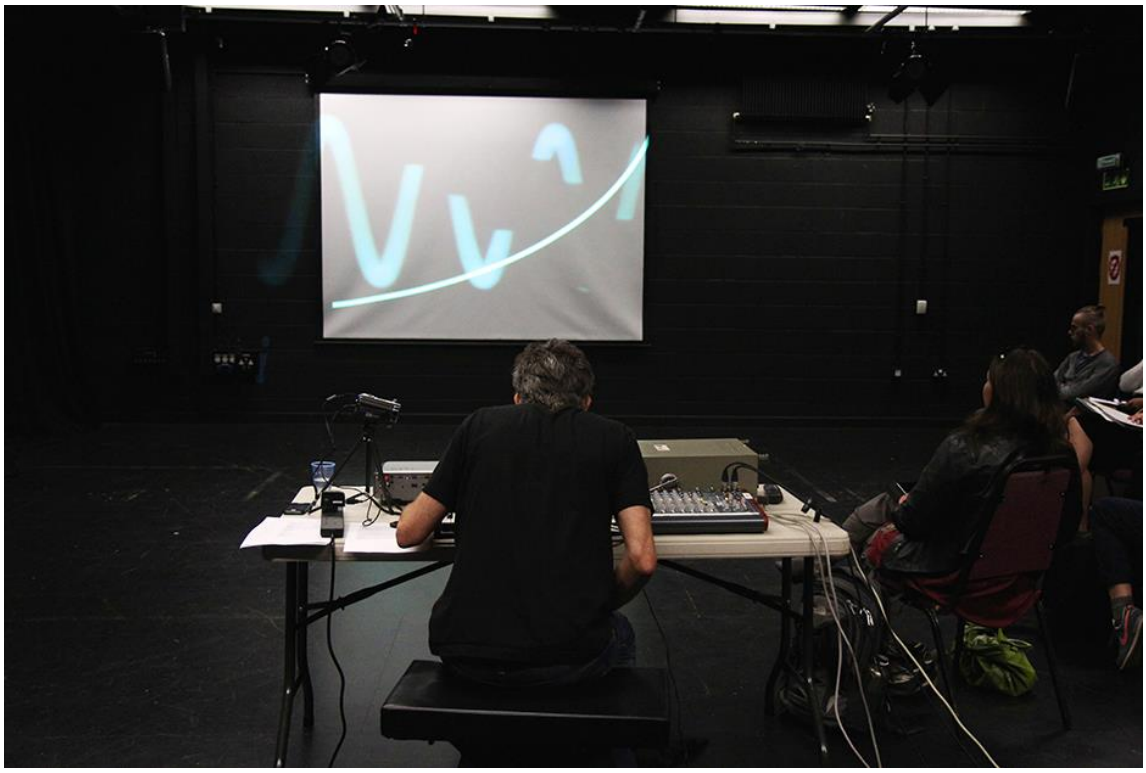

Fig 21. Waveform of sound, visualised and projected onto wall. Image: Ethan Folk

This wave shape changed during the performance. Initially the sound was that of a pure sine wave, sounding clean and mechanical. A single mathematical, and rather unnatural or mechanical tone with a smooth and regular waveform shape.

Little by little, the tone was ‘modulated’, whereby additional waveforms were combined on top of the existing waveform to change the sound. The tone and image became wobbly, then wobbly and shaky. Looping oscillations were added to this sound, then yet more oscillations on the oscillations until the tone and image became steadily more complex and increasingly unstable and noisome. Eventually the introduction of many modulations filled the entire sound spectrum and the tone became like white noise[xviii]. The projected image of the waveform was now a chaotic zig zag.

This final sound state was played at slowly varying volume from perfectly audible to

totally silent (another order of oscillation from totally on to totally off) - ebbing and flowing. The digitally produced sound now strongly resembled a rushing ocean with waves washing in and out. The sound had moved from clean and mathematical to cluttered and oceanic by overlaying different types of oscillation. The work presented a transition between extreme representations of waves, from clean to cluttered, so relating the engineer's isolated waves (shown here as the initial sine wave) and the cluttered experience within the sea, which was closer to the sea drawing (and represented at the end of the performance).

Two types of wave – secondly technological infrastructure

Throughout the performance, a series of images were over-projected on the waveform shown on screen. These were related to the second waveform of interest to this performance. They were of economic and social data relating to the equipment being used. For instance, the stock price of the Leader Corporation that manufactured the aged oscilloscope was shown (figure 22). Another noisome wave – a graph of levels of EU waste including electronic goods – was shown as well (figure 23). And so the sound produced by the equipment and the socio-economic changes produced by the equipment were both visualised simultaneously.

Different scales at the same time

The performance presented the process of moving from isolated data (the sine wave) towards multiple overlapping data streams (the white noise of oceanic, nested waves). It developed an approach started in the earlier drawings and sandpile work and attempted to show material behaviours of non-human processes, that are also part of human experience. In this case the behaviours it showed were intensive waveforms.

The work explored how sound can overlap and mix at different scales in a way that resulted in thalassocentric characteristics (familiar to anyone who has visited the sea). The final dirty sound was very like the rush of waves growing and receding. But these nesting waves were also shown to be occurring at the same time in different ways. There were mores changes occurring than just those within the audible frequency of oscillations per second.

A sound was slowly (over the course of a couple of minutes) becoming increasingly

nested and noisome. Simultaneously, a very much slower process was taking place through technologies and their entanglements with society, economy and resource flows. This was the waveform of manufacture, investment, purchase, use, and wear occurring in and through the equipment being deployed in the performance – the art apparatus. The inclusion of a relatively old piece of equipment emphasized the lifetime of these pieces of equipment rather than showing them as tools separated from their production and disposal. This wave was taking place on a much slower scale of decades not minutes – as demonstrated by the instruments used. The apparatus was also drawing a graph of its own emergence and collapse at a much slower (temporal) scale, but still live. The equipment contributed to other peaks and troughs. The stock price of the companies that manufactured them went through cycles. These companies were themselves part of a wider sweep of long term economic growth and resource use. That wave had not finished just because the equipment was purchased and in use. At some time it would be discarded or break and perhaps be replaced or upgraded. Its ownership and maintenance becomes visible as one scale of investment and disinvestment when looking in this intensive way that draws on previous findings.

So the work sought to connect the nested noise of the sea with the nested waves of the apparatus.

Figure 22. Stock chart of Leader Corporation, shown as part of performance for Performing Site (Business Week, 2014)

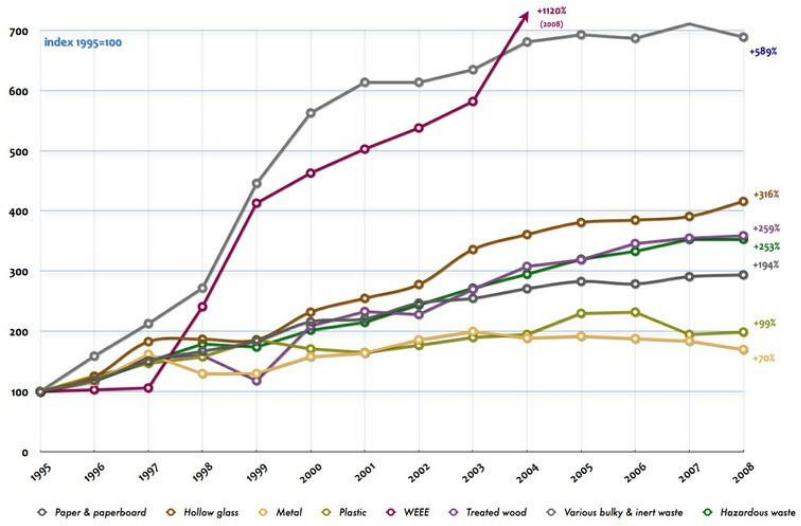

Figure 23. A curve showing the increase in electronic waste in the EU, shown as part of performance for Performing Site (European Environment Agency, 2010)

Commentary on the Work

These graphs of the economic and material changes associated with the equipment that constituted the art apparatus formed part of the artwork's attempt to see the movement of the corporate, industrial infrastructures that are behind its own production. Showing these, otherwise-hidden, connections makes two points. Firstly, this act of production is part of a large system that causes degradation (as, conceivably, almost any act is). The art can also cause damage. Change is enacted by art on the world. Secondly, the process is dependent upon a complex web of systems of production, transportation and remuneration. Such an extensive system, which is highly connected can be brittle. Given certain types of change in the world (economic, environmental, political...) part or all of this system may not function or exist. In these terms, the production of an art apparatus acts to demonstrate its own precarity. Change goes from the world to art. These two points are perhaps the same point, expressed from two directions.

Apparatuses described above as scientific derive data from and draw attention to one part of their structure – their apparent end or point of focus. The scientific apparatus avoids cluttering this view of an object presented as separate from it by ignoring information produced from elsewhere along the apparatus. This includes the subject entanglements of the apparatus. The subject that seeks to know that

object is excluded from view. We are directed towards the ‘pointy end’ of the apparatus, by which I mean that end that in some way reaches towards the object of its enquiry. This was largely the case with the drawings. The extended processes generating these drawings, the tools they used and the equipment and conditions necessary for going into the sea to return with some form of trace (logged in memory ready to be processed by a skillset built on learning and tradition) were not clearly presented in the drawings. Much of the apparatus (in this case swimming equipment, but also technical skills and approaches) was obscured.

Here however, information coming from points along the ‘length’ of the apparatus is included. The output of the apparatus is produced from along its length, resonating through its linkages and entanglements, connecting sea with society, subjectivity with economy and industry.

The art apparatus produces waveforms in different dimensions. Both at its focal point (the sound, the image from the oscilloscope) and from along its length and history and entanglements. These secondary sets of waves (economic impact, corporate growth, waste streams) were not so easily visualised or presented. But they were nonetheless still produced, in some place and some time at least in part, by those same instruments. These processes of emergence and collapse are always produced in the use of any 'technology'. But they are not usually made visible. In some ways this apparatus was close to Flusser's apparatus since it looked closely at human technology, but it was directed towards ecologies that were non-human and it was understood in ways derived from the sea. It was also different to Flusser's apparatus in the way that it presented information in two ways; its objective point and from along its subjective length.

This way of using and presenting an apparatus is markedly different to how they are used in scientific practices. It moves from considering waves as isolated artefacts (in sound, in water, in economics) to a nested, entangled perception appropriate to ecological and thalassocentric knowledge.

But it is not so easy to see processes such as investment, technology and stock price in the same category as waves in the sea. There is no theoretical reason why this should be the case. The idea of waves as distinct mathematical functions (such

as sine) is not incompatible with the idea of 'noise' as a type of combined wave. This sound-based work very clearly demonstrated this by layering simple waves till noise was made. And that noise did sound like the rush of surf. The finding of noise as a thalassocentric condition was very useful. This gives a sense of connection and change at many levels. The difficulty was in the different types of intensity and trying to relate these two different types of wave shape together.

Did this work show a common nature among oscillations in the sea, in technology and in sociocultural conditions? It attempted to do so by using an art apparatus mediating between realms often considered as incommensurate. Yet it still ended with a sense of disjunction. There is a clear jump in focus from one of these sets of nested waves to the other. This apparatus was able to show multiple movements along its length. It was able to link to multiple changes. But it did not easily demonstrate the linkage between them and seminar participants commented on what seemed like two separate stories within the piece.

Using both contemporary and redundant electronic equipment, it showed an output that relates to the object of observation (sea-like conditions). It also attempted to show a trace that was produced by parts of the apparatus itself. It presented an arts practice that sought to read the process of its own writing. Along with the multiple scale waves produced at different points of the apparatus and the focus on emerging and collapsing technology this is a valuable finding. However, the disjunction between the types of intensive waves is an important question raised by the work that needs addressing.

The disciplinary combinations and alignments in this work placed it firmly within a performative arts practice. This performativity helped show movement and change. It was dynamic and restless. Its point of departure was a technological or scientific one. This was also appropriate since the aims of this research embrace environment and material change. And reading further into the work, the references to economics helped open up and make visible the hinterland of the art apparatus, how it presented a certain understanding of the sphere of technology and industry. However, the work did not allow the range of connections to relate in a clear manner. The use of historic or redundant equipment worked toward the aim of combining these different realms better than if new equipment were used. The type

and duration of performance might not have helped with this complex, multi-scale aim. Despite being able to show dynamic change, The audience watched a prepared event lasting only a few minutes. The helpful finding that I took from this was to focus on the performance of the apparatus instead of the performance of the artist. This is what I did with the final series of works, which better showed their own emergence and collapse.

I will go on to develop this idea of apparatus that seeks to present the conditions of its own deployment. I will show that the distribution of the apparatus extends in time, throughout communities and infrastructures of knowledge. The emergence and collapse of the apparatus itself will be key to presenting this.

Figure 24. Producing and changing waveforms. Image: Ethan Folk

This work was helpful in how it showed an arts practice that sought to read the process of its own writing. It showed waves of different scales and different types of intensity. It was not necessary to introduce or diffract very different types of knowledge in order to interpret this work. This suggests that the initial stage of describing the context and assembling the critical tools is nearing completion.

Different types of intensive change and the conceptual space in which they are shown

However, the work did not easily manage to relate the different types of intensive change that it addressed. There was a difficulty understanding how environment and techno-social conditions connect. And remembering findings from previous chapters, the subjective insights of individuals are not easily related within this work, even though they are important to changing ecologies and their perception.

There is still a disciplinary or methodological separation between *what* is looked at and *how* it is being looked at. This could also be a criticism of Panarchy. The theory has powerful insights, but it is a scientific method that relies on presenting itself as objective. It produces knowledge that appears to sit in a separate location to the things that it looks at. Yet the criteria for thalassocentric apparatuses are that they do not sit apart from what they look at. This work attempted not to sit apart from what it looked at, but still there was a separation of sorts.

All of these questions (of separate realms of relevance and of the location of knowledge) relate to the conceptual space in which the work is produced, and which it presents. Is this a work about sound, or about technologies? The overlap is not clear here. So having suggested an intensive link between economic growth, environmental degradation, changes in materials such as sand and the way artworks can effect change in the systems they are part of, there arises the question of the space in which these very different phenomena are understood to move and change. And that space must also include the artist and the artist's process that addresses them.

The task of assembling and relating these issues requires all the findings from the first section to be arranged and related. This is, to a large degree, a philosophical task and I will use a body of philosophical work to complete this process of relating the work so far.

This will be undertaken through the work of Deleuze and Guattari that (like all the conceptual tools so far) can be interpreted as showing connection and change on

different scales. There are many similarities to the perspectives developed already, but useful additional points too. Guattari presents a way of addressing the difficulties of multiple realms that I have sought to include. His theory of ecosophy will relate nature, society and the psyche. Deleuze's work with Guattari will also include its own ways of working as part of the changes it looks at. These philosophical perspectives will complete the assembly of a thalassocentric perspective in a way that allows the research to move on to review and final production of artworks.

Chapter 6 Changing, Connected Philosophy of Multiple Scales

Introduction

The issues laid out so far still retain a certain distance between them. They do not relate and sit together as clearly as they might. These issues can be brought into much clearer relationship by addressing the conceptual space in which they all sit. This is the primary job of this chapter. This might have been attempted earlier, but the route to this point has been important as it addressed issues and examples that needed to be taken on their own terms.

Conceptual space of connected change

So reflecting on the types of movement and shape shown by Panarchy, drawings, artworks in sound, technology and sand, and insights derived from them, I will seek to describe a space that can include these perspectives in a way that is appropriate to a connected, changing sea and appropriate to the connected issues of the anthropocene.

Up to this point I have described a range of conceptual spaces within which the sea is described or understood: those encompassing or excluding society, those of industry, of different disciplines or experiences of the individual; spaces of culture and possibility proposed by artists such as the Otolith Group. Various spaces in which objects and subjects address each other and in which events take place or hover with possibility.

So the space in which I now seek to describe these events is not going to be an empty space. It is going to be a space (if indeed that is the right word) of change and movement. It will need to be a ‘space’ that relates the contexts and findings of the research so far. So it will have to be complex and dynamic, with multiple types of material agency acting together to result in the emergence and collapse of intensive structures and events. It will have to be relevant to the sea in particular, so these forms of connected intensive change should be perceivable as wave forms or

oscillations over many scales. It will need to connect different types of event (such as environment, human thought and social organisation). And importantly, it must not be a separate space that constructs a distant and isolated form of knowledge that it is apart from its own materiality or its own methods and processes. In other words, its apparatuses and the things it looks at must occupy the same reality. I list these again.

Criteria for Conceptual Thalassocentric Space

- relevant to the sea
- complex material agency
- emergence and collapse of intensive waves
- connect different types of event
- own processes part of what it looks at

Aims of this philosophical task

These might seem a very difficult set of criteria to fulfil, but the philosophical perspectives below should describe this sort of conceptual space well as Deleuze and Guattari have been influential on many of the figures that I have referenced so far. I will start by introducing the work of Deleuze and Guattari, then describe the spaces that their work involves and something of how they are structured. I will then address the movements and changes in Deleuzian space before relating their work to the concepts this research has produced so far, including a sea-based perception.

About Deleuze and Guattari

Gilles Deleuze (January 18, 1925–November 4, 1995) was an French Philosopher some of whose key works were completed in collaboration with psychoanalyst Felix Guattari. He is heavily referenced in the works of Bennett, De Landa and others that I have used above.

Despite pre-dating much of the ideas I have used already, the work of Deleuze and Guattari is so versatile and influential that it is worth addressing directly. I will describe elements of Delezian philosophy that contribute to a sense of shape within a conceptual system. These include the *plane* or *plane/s of immanence* and I will

also describe events that animate those planes such as d*eterritorialization* and r*eterritorialization*. While I describe the work of Deleuze and Guattari as about change, and despite being a philosophy of thought, I will show how it is also about 'materiality'. This important point relates the work to shapes of change in ideas and in other material contexts. I will underline the multidisciplinary relevance of the conceptual space described here using the work of relevant scientists.[xix]

I will show how Deleuzian thought demonstrates a way of thinking that is a continuation of the world that it seeks to think. The process of thinking will then be shown as if it were made of similar materials, exhibiting similar behaviours to systems that exist aside from thought. This relationship between processes of enquiry and the world they enquire of, offers an ecological solution to the problem of bicameralism. A discussion of these philosophical ideas will suggest that thoughts and the materials of the world move and change in similar ways. This will be helpful for arts practices that also seek to show these movements and changes.

Guattari takes up and develops this theme to show a continuation between thought and identity at the scale of individuals (of subjectivity, or subjectivities) and the environment as radically ecological. In fact he uses a particular phrase for this combination of human mind, society and nature – ecosophy (Guattari, 2005). Having encountered different realms such as human society, imaginative space and environment, Guattari relates these together in a coherent way. This will help resolve the methodology and it will help categorise and evaluate artworks reviewed in the next chapter.

The Structure of Deleuzian Space

Fractal oscillating space

Deleuze and Guattari's philosophy appears to do many things, and resemble many forms with numerous elements. It is described as being an infinite virtual field (Deleuze, Guattari, 1980: 13). That field is itself approached using a concept described variably as the plane of immanence or plane of consistency.

The concept of plane is initially borrowed from anthropologist Gregory Bateson, when he attempted to describe levels of continuous intensity within Balinese culture that are not interrupted and which do not climax (Deleuze and Guattari, 1980: 175).

Deleuze scholar Khalfa sees Deleuze's whole ontology and the plane in particular in wave terms. 'Concepts are like multiple waves, rising and falling, but the plane of immanence is the single wave that rolls them up and unrolls them. The plane envelops infinite movements that pass back and forth through it' (Khalfa, 2003: 9). Already, similarities with movements of the sea are apparent. The Deleuzian concept of the plane helps us understand and describe a conceptual space which includes thought *and* material process. And the plane exists on many scales. When compared by Deleuzian scholars with ways of understanding physics, we see the plane as fractal.

Fractal structure

Comparing physicist David Bohm with Deleuze, Murphy the writer on Deleuze articulates a conceptual space that is fractal, derived from folding and unfolding events over infinite scales and repeating conditions (Murphy, 1998: 225). These ideas occur at the tiniest of scales and are repeated or stacked at ever greater scales, in ways that are reminiscent of the shapes and changes (marine, ecological) discussed in the research so far.

For instance, Panarchy describes how change can occur (and continue) on a fixed local scale[xx]. Likewise change in sandpiles and in artworks can also precipitate upwards leading to greater emergent structure at times of opportunity and precipitate downwards at times of fragility, leading to cascading collapse.

Paradox and plane

But this space of the plane is not easy to touch or see. It is clearly not extensive. It is not easy to pin down in description or thought. The plane is *paradoxical*. The plane of immanence is 'At the same time, that which must be thought and that which cannot be thought. It is the non-thought within thought. It is the base of all planes, immanent to every thinkable plane that does not succeed in thinking it. It is the most intimate within thought and yet the absolute outside' (ibid: 24). Here we find a description that is playful, elusive, or outlandish. One of the difficulties of Deleuzian thought is that it does not initially appear clear if it is the *descriptions* being used that are outlandish or it is the *things* that they describe. The more entirely this work of thought and change is understood, the more it will be obvious that attempting to answer this question is not helpful. The method of thinking and the thing that is

being thought appear to infect each other.

Particularly paradoxical is the variable number of planes that are describe. Are there lots of them, or only one? At times the plane is singular, being of 'Pure variation' (Deleuze, quoted Khalfa, 2003:39), but it also has varied and distinct planes of immanence which 'succeed and contest each other in history.' (ibid:39). It exhibits a strange kind of geometry that is hard to pin down, but that allows more and more possible spaces of connection.

We see that the Deleuzian plane exists through multiple apparent identities, in multiple combinations and different readings. The authors go on to describe this elusive nature in terms that echo complex systems, evoking fractal structure repeated over different scales.
'Diverse movements of the infinite are so mixed in with each other that, far from breaking up the One-All of the plane of immanence, they constitute its variable curvature, its concavities and convexities, its fractal nature as it were.' (Deleuze, Guattari, 1994: 38).
The arrangements, shapes and spaces in Deleuze's philosophy (including plane/s and also smooth space) are fractal in some ways.

Like the conditions of the sea, this plane is elusive and can be defined only partially. It involves change and flight and is less immediate than the movements of salt water alone. And if we consider the movements of the waves, their structure and change then we are looking at the movements *of* the movements. This is a second order of change; of intensity. Likewise, the ideas presented here show intensities of thought. Taking a step back (or as I discuss below, not back, but into another position of observation) allows different types of change to appear more similar. So in some way Deleuzian planes and space connect multiple realms. But how? The idea of folding is helpful here. It shows a movement, similar to a wave in many ways, that bends to produce an apparent outside or position of difference. However, following a folded plane is possible in a way that shows that outside and inside are connected.

Fold

Having started this research with the recurrent problem of disparate binaries (eg between mind and the world, nature and technology), the 'language of the fold'

dissolves dualisms. Foreground and background, inside/outside and identity/multiplicity can also be seen as co-produced. They appear connected or implicated in each other (Bowker in Jensen, ed. 2009: 126). And it is easy to see a fold as like a wave.

The inside and outside are folded one into the other to produce locations that are liable to change but that cannot be isolated (ibid: 129). This applies across different 'sets' of out-side or outland, such as self, society and nature. Bowker talks about Deleuze's value in releasing these trapped locations so that the body is not trapped behind the skin (indeed the intestinal tract can clearly be understood as a form of outside), the soul is not trapped inside the body, and the state is not trapped inside walls (ibid: 129). These plane/s co-construct the realms of subject, society and the material world (ie the natural environment) and they do so by a movement of different, nested scales that change and can be thought of in terms of waves. We see that individual events or identities emerge from their contexts. Using these ideas it is easier think of issues or conditions as specific yet connected, whether they are natural, technological or about human subjectivity.

This form of folding can be seen to relate apparently different realms such as mind and society. Comparing perspectives from physics and philosophy strengthens the argument that the universe, including the humans within it, operates as an 'Order of undivided wholeness' in the words of physicist Bohm (Bohm 1980: 158). It also provides multiple cases of shared descriptions of the behaviours of that undivided wholeness.

Murphy says Bohm uses a 'Melange of discursive registers' such as quantum field theory and psychoanalysis to describe different intensive events as folded. He describes a process of fluctuation or folding of emptiness, allowing an infinite number of fields (akin to Deleuze's 'series of intensities') which interact with one another (Murphy, 1998: 223). This oscillating fold is familiar to the movements of sea – nested, combining, changing as it moves back and forth. The movements of the sea are helpful when trying to think these elusive and paradoxical ideas, as long as these movements are thought of as intensive.

Bohm observes that subatomic phenomena have their bounds and we use the word

'measure' to indicate this (Bohm, 2002: 158). He goes on to extend this structure to cultural systems – of human behaviour. 'It is significant to note here that in ancient times the most basic meaning of the word 'measure' was 'limit' or 'boundary'. In this sense of the word, each thing could be said to have its appropriate measure. For example, it was thought that when human behaviour went beyond its proper bounds (or measure) the result would have to be tragedy (as was brought out very forcefully in Greek dramas)' (ibid: 150). Here a description of the start and end of a wavelike event is a helpful interpretation.

This comparison (between physics and philosophy) shows movements of different orders, or layers of waves, folds or oscillations. Around the bounds, measures or outlands of these forms, there is collapse and emergence into new shape and new becoming. This is an understanding of change that is recognisable from the sea. It is material (in part derived from physics). It is applicable across different realms or disciplines. It can describe the movements in ecologies and human thought too.

These interdisciplinary interpretations have shown how the perspectives of Deleuze and Guattari start to offer a way of seeing human and non-human systems as part of the same types of space and how this space is fractal and shows wave-like behaviour. Deleuze and Guattari describe human subjectivity as existing within this space of non-human materials, which I will describe now.

Deleuze's subject in folds

For Deleuze, this fractal structure of folds leads to a description of how human subjectivity fits within other types of event. Subjectivity is found as a high level, which sits on top of many other planes or folds. And here, it might be thought of as a plane of different order or level. The subject is 'A complex fold in the infinite surface of times and spaces that, like origami, can be unfolded and refolded into different shapes.' Alternatively, this could be thought of as a ripple on a larger complex swell of sea movement. Likewise, for Bohm 'Consciousness and the unconscious are merely moments that enfold the whole, in the same way that a fractal like the Mandelbrot set repeats its largest-scale structure at every smaller level of scale' (Murphy, 1998: 226).

So, I have described something of the structure of Deleuzian space and in some

ways (since that structure is made through folds or oscillations), it is hard to separate the structure from the events that happen in that space. But there are terms that Deleuze and Guattari use which will allow a more detailed discussion about movements and changes occurring within the space I have described. These include deterritorialization and reterritorialization.

Movements and Changes within Deleuzian Space

Deterritorialization/Reterritorialization and how to apply it

The dynamic and intensive structures described above exist over many levels or scales. Looking back to Panarchy and other complex processes we also see many levels. And on these levels changes involve emergence and collapse. Events come into being or into shape and they move out of that shape. The Deleuzian term deterritorialization is helpful now for thinking about these moves in and out of states of being and states of order. In *A Thousand Plateau* 'deterritorialization' refers to the process of 'animating a strata' (Deleuze, Guattari, 1980: 209).

Deterritorialization and its companion, reterritorialization appear to act as complimentary figures. They can be thought of as divergent tendencies both undermining and supporting stability (arguably another type or application of oscillation[xxi]).

But can deterritorialization be thought of as a positive event or a negative one? 'Deterritorialization is the movement by which "one" leaves the territory. It is the operation of the line of flight.' (ibid: 508). So this movement is a divergence. It is also a flight from assemblage and use, maybe then a type of falling apart. *'Lines of deterritorialization*...cut across' or 'carry away' assemblages (ibid: 504).

In Deleuze's words, deterritorialization can be interpreted as either negative, or positive. Perhaps based upon the particular subjective position from which it is viewed. In the later case of positive emergence it 'Brings about the creation of a new earth, in other words, when it connects lines of flight, raises them to the power of an abstract vital line, or draws a plane of consistency' (Deleuze, Guattari,1980: 509). So at times it is destructive, or entropic. A type of collapse. And at other times it can result in new forms and possibilities. It appears to be emergent.

But the operation of deterritorialization is complicated as is its various descriptions. Depending on Deleuzes relationship between *negative* and *absolute* deterritorialization, he maps 'at least four forms of deterritorialization that confront and combine, and must be distinguished from one another following concrete rules' (ibid, 1980: 510). How is this set of different events to be understood accurately and best put to use? Is it necessary to map and understand these ideas exactly as they were intended. Indeed is that even possible? This becomes a question of how to apply the ideas of Deleuze and Guattari. Can they be taken alone and followed exactly, making some sort of mirror image or replication (as Haraway described above), or do the Deleuzian ideas diffract to produce new knowledge when they are applied?

Writing of interdisciplinary application of the philosophies of Deleuze and Guattari, Bruun Jensen and Rodje write that 'Deleuze and Guattari's own approach applies one form of knowing to varied circumstances. It is 'pragmatic'... and it does not aim to 'reproduce the meanings and agendas of those from whom they learn, but to extract their concepts and graft them on to new concerns, placing them in proximity with other issues... If this is not a representational strategy, neither is it a purely discursive one. Rather it is performative and fractal: a strategy of the *and;* evaluated according to its ability to move between disciplinary domains and hierarchies and thereby generate new capacities for thinking and acting' (Bruun Jensen and Rodje (eds), 2009: 27). This approach to using Deleuzian ideas suggests that the ideas themselves come apart, and reassemble. They graft onto new uses and make new applications. This is highly appropriate given the context I have set out so far in this research. It emphasises that structure (of ideas or materials) is about use. It is performed. This is a thalassocentric perception. The structure of the sea comes from how it moves and changes. It is useful for interpreting the ideas of Deleuze and Guattari. It is useful for understanding ecological renewal. It is useful for thinking about circulating oscillations of the sea and it is very useful for considering creative strategies within artworks. The art apparatus I am developing must be pragmatic, performative, fractal and about collapse and emergence.

Following Bruun Jensen and Rodje and the application of these ideas to my research, I will now be able to use the idea of deterritorialization as helping to show creative structures and events such as those of collapse and emergence. Ultimately,

deterritorialization with its compliment, or opposite, reterritorialization can be thought of as developing dynamic creative change. These two movements or tendencies are common to complex systems and to artistic process. They are about creativity. This two part tendency, seen already in different parts of the research is described in further detail now.

Dynamic creative events of emergence and collapse

I have described the events of deterritorialization and reterritorialization. Elsewhere events are described as 'becomings', or 'dark precursors', which are other 'mechanisms of immanence' evoking new directions and challenge to existing structure on Deleuzian planes (De Landa, 2004: 123). In Deleuze's work, deterritorialization and reterritorialization help to develop a philosophical system that neither descends into total chaos, nor solidifies into stultifying fixity, but moves back and forth producing possibility. It is neither white noise, nor the perfect sine wave of a clean stable sound, but lively variety. It is about creativity. According to Bell, Deleuze and Guattari develop a philosophy of difference 'a dynamic system at the edge of chaos, a system that is *both* complete, ordered, *and* incomplete and chaotic.' (Bell, 2006:10) This seeming tension is explained by Bell through Deleuze's notion of the double bind 'God is a lobster, then, a double pincer, a double bind, a double articulation' (ibid: 9) This critical point between wild collapse and stultifying stasis also supports lifelike behaviour in other complex systems. It compares with a two-part tendency of creativity within systems-thinking as discussed in previous chapters and models of complex behaviour balanced between excitement and stasis (such as critical stability in sand, or the computer based 'Game of Life', which must 'have just the right sort of Order, with just the right mix of freedom and constraints, growth and decay, rigidity and fluidity, for good things to happen at all' (Dennet, 1996: 221)). We see again a system of thought that addresses thought itself as behaving in the same way as dynamic and life-like systems.

Bell also emphasises the similarity between the creativity of non-human systems and the liveliness of disciplinary processes of thought. Deleuze and Guattari's project maintains 'both its stable strata and its unstable, deterritorializing flows. Without the former, a living organism dies (or a philosophy slips into disordered nonsense and says nothing), and without the latter, an organism is unable to adapt and will also die (or a philosophy falls into a mindless repetition of cliches and

platitudes)' (Bell, 2006: 4).

So the creative dynamism of this system of thought becomes of great relevance for this research. It offers important lessons for artworks that seek to show the change of non-human systems, because it reminds artists that the movements of those systems (be they the sea, ecologies, societies or materials) are creative. It connects thought and matter through creative process. The conditions I have looked at so far are now seen to share similarities with the movement or change of creative acts. This set of insights returns the research towards artistic disciplines and processes of creativity they deploy, using collapse and emergence (for instance in materials).

Assessing Deleuze Alongside Other Findings So Far

Having described some of the many aspects of Deleuzian space and the events in it, I can now summarise how this is relevant to other findings so far in the research. This includes the movements, change and connection of the sea, the problematic bicameral separation between human and non-human worlds and complex systems such as Panarchy discussed previously. This will help us in the task of consolidating a thalassocentric perception, with which I might then consider artworks and produce final artworks that respond to these demands.

Interpreting Deleuze and Guattari in ecology and in sea

Many points of connection have been noted between Deleuzian thought and the issues dealt with by my research so far. I will now look to see if ecology and the conditions of the sea can be referenced even more helpfully.

Connected plane/s – Guattari and ecology

Writing alone, Guattari opens alternative possible readings here which are helpful for both the sea and for ecology. 'Eco-logic...concerns itself solely with the movement and intensity of evolutive processes' (Guattari, 2005: 136). His interpretation of connected conceptual spaces connects human ideas with processes dealt with by natural science. The ideas Guattari develops here may help us confirm our inclusion of different disciplinary fields within an expanded ecology.

Three Ecologies

As noted above, Guattari proposes alternatives to a separate subject and world

(termed a Cartesian cut) in a very short, but significant text, Three Ecologies. He criticises 'partitioning off the real into a number of separate fields' (ibid: 134) given as 'the psyche the socius, and the environment' (ibid:134). Rather than separate realms of the world, there are a paradoxical and elusive structure of plane/s that are wrongly considered as separate. Instead of needing to understand how to select and combine disparate elements (such as psyche and socius), it becomes necessary to recall this 'single wave' that resists partition. He develops a project which is not a purely psychological or social one. It is environmental too. Rather than specialist management by technocrats with objectified disciplines, Guattari calls for collective management in the face of a 'Nature [that] kicks back' (Guattari, 2005: 134). This moves away from a view of an atomised world, with distinct parts. Instead we are shown a connected one that can react in unexpected ways. And we see three strata that could help us reassemble a thalassocentric perspective of multiple planes.

His argument connects the disappearance of animal species with the 'Words, expressions and gestures of human solidarity' (ibid: 135). A new method of speaking about these conditions and engaging with them requires a logic that differs from that of scientism and the Cartesian cut. Again a clear object-subject division is problematised.

The problems that Guattari seeks to counter are distributed through the natural, cultural and socio-economic world and through the individual subjective and collective cultural realms. Hence a separated or externalised objectification of these issues will not suffice. He cautions against replicating the modes of thought he describes as 'pathogenic models' (ibid: 138) of pseudoscientific modes of enquiry. This metaphor is itself an interesting use that combines thought, nature and society.

A pathogen is a non-human agent of disease. So he describes the structure of subjective habits; individual and collective beliefs in terms normally used for living agents in the natural world. This strongly evokes the spirit of Guattari's opening quote from Gregory Bateson's *Steps to An Ecology of Mind*. 'There is an ecology of bad ideas, just as there is an ecology of weeds' (Bateson, 1972: 492). We have a quote that talks of the human mind (but in its material structures on an impersonal collective scale). We are seeing mind as society. These human structures of

multiple scale are invested with their own living agency. But that is described using the agency of non-humans; the most derided, microscopic sort (weeds or pathogens) at that. Vast collective subjectivies are described with the agency of tiny non-humans. This is a metaphor that criss-crosses back and forth over previously accepted bounds and scales between shape and life, agency and the inanimate, human and non-human, as if suturing a cut, or traversing apparently internal and external folds in a plane.

Returning to the sea

It is now possible to apply Deleuzian thought to the sea and to environmental issues and contexts. From a marine perspective we might, naively, see deterritorialization as the growth towards a crest and reterritorialization as the fall from a peak within wave movement. There is some justification for describing oscillations this way. The maximum displacement in a wave's amplitude is far from static equilibrium and it is this disequilibrium that returns the water mass towards (and then beyond) a point of stasis. This is a type of animation, restless and recurrent, that can happen and mix on many scales, as we have seen.

But this extensive interpretation is too narrow. The animation I described here is within a single marine 'plane'. We have seen how the context I am addressing connects scales and orders of intensity that move through *different* planes or folds. Developed along these more intensive lines, the theories of Deleuze offer tools for considering the spread of collapse, breakdown and remaking of varied planes of immanence and agency across sea, society and its understanding. This is an oscillating figure of change that connects across and between orders and scales. The change could be travelling through materials, industries, populations of humans and of non-humans. It is the intensive wave that connects these extensive systems that is the focus of description here.

It is important not to think of deterritorialization and reterritorialization simply as measurements of a bounded system, rising and falling. The example of Panarchy is a useful reminder of nested scales that allow events to cascade from small to larger orders. It describes how system behaviour or frailty is a type of intensive behaviour that might travel or be communicated. Within the scale of the individual, extremes of circumstance may arise (feast, famine – whether of material or other resources, or

emotions for instance) and have impact upon the circumstances of that individual. Given the right circumstances (opportunity or precarity) this change might spread through a population. When populations surge or dip, this may affect a habitat. Changes in habitat can cascade across a region… and so on.

I am reading deterritorialization and reterritorialization in these terms as change – *becoming* – across many scales and also as the agent of becoming between scales and between realms. Oscillation spreads, is damped, or precipitates further oscillations. Multiple waves take place on top of each other over different scales, combining and cancelling each other. Having started with the movements within the sea, this reading of deterritorialization can now be applied to cultures and economies that are connected with the sea. It can help us understand the flows of energies, resources, by-products and other change that cut through ecological systems. In the light of this interpretation, I will use this figure of complex, dynamic, oscillation and change along a sort of plane as a way of understanding knowledge processes within art, which involve non-human resources, but also help shape human subjectivity.

So while Deleuze's ideas of folded planes of deterritorialization and reterritorialization are not universal interpretations for waveforms found in the sea; in experience; or performed by beings and phenomena entangled with the sea, these ideas have clear relevance. The difficulty of perceiving structural change across different orders and through different substrates is more manageable. The connections of deterritorialization and reterritorialization across these scales are emerging, but only when viewed from a certain perceptual stance.

I finish this chapter with a comparison of different conceptual spaces that will complete the thalassocentric perspective. As is already obvious, the space of perception that a thalassocentric apparatus develops must not be separate to the space it exists in. It must be immersed. This is an issue of critical distance that allows an idea to stand separate from the conditions it is about. These ideas are best described by a comparison between Kant's transcendental aesthetic and the Deleuzian plane of consistency. Once this is completed, this chapter will have done its job.

Perception and Space

Kant's Transcendental Aesthetic is a key staging post in the modern conception of critical distance and knowledge. It constructs a certain kind of space. It is valuable to quickly consider how Kant's Transcendental Aesthetic differs from the perspectives developed by Deleuze, to help construct a thalassocentric perspective. Returning to a further consideration of Deleuzian planes will help in this comparison.

Janiak (2009) explains that Kant's approach to ideas about space centre on the role of human mind. He emphasised that for Kant, understandings of space and its relation to objects are about correspondence with mind. Kant claims that space has "transcendental ideality". For Kant, knowledge is not physical, or historical, it is located in 'A domain (the transcendental) more fundamental than the ideas it subtended' (ibid, 2009).

One important consequence of this is the possibility that thought is the product of the mind, occupying an additional dimension of critical distance, a 'special epistemic realm' (Gutting, 2014), namely transcendental subjectivity. For Kant, knowledge is sitting apart from what it knows in a new dimension of perception[xxii].

However, Deleuze and Guattari can be interpreted as proposing spaces that are not transcendental. In so far as Deleuze and Guattari theorize the 'inexistence of the whole,' or the 'nondenumerable' then Jeffrey Bell and others associate them with thought that avoids this aspect of Kant's thought. 'Unlike a transcendent heaven which exists as a *separate dimension* from reality, Deleuze asks us to imagine a continuum of multiplicities which *differenciates itself* into our familiar three-dimensional space as well as its spatially structured contents' (De Landa, 2004: 23). Looking again at planes is helpful in the light of this to help understand the difference.

In *A Thousand Plateaus* Deleuze talks in detail of ways of conceiving of the plane (although elsewhere planes of varying sorts proliferate. His ideas are never stable and, as we have seen, must be applied in creative ways). He opposes the *plane of organisation* or development with the *plane of consistency* and composition (Deleuze, Guattari, 1980: 294). Important differences exist between these two planes, or two conceptions of plane, from the perspective of this research. I will

describe them now.

Plane of organisation:

The plane of organisation, firstly, is hidden, inferred. It is 'A plane of transcendence' (ibid: 293) (whereas in contrast, the plane of consistency is 'given' and 'necessarily a plane of immanence' (ibid: 294)). If the plane of organisation can ever be said to be immanent, then that is only by absence, ie analogy, metaphor, metonym etc. where one thing is taken in the place of another that it is different to. The plane of organisation can be thought of in Kantian terms. For Deleuze this plane causes and gives structure and genesis and it forms subjects. 'It exists only in a supplementary dimension to that to which it gives rise (n+1)' (ibid: 293). The theory of Panarchy operates like this, being a 'metaphor'. It is not contained within what it gives rise to. 'The developmental or organisational principle doesn't appear in itself' (ibid: 293); ie it retains objective critical distance able to talk about something that it is not. Likewise, academic science and its apparatuses discuss, or form, understanding of a world other than its own. Science uses social, political and economic processes to produce knowledge that is presented as objective in that it is separate from the realities that perceive it. 'The plane can always be described, but as a part aside, as ungiven in that to which it gives rise' (ibid: 293). A removal and separation, reminiscent of bicameralism returns with this form of plane.

Plane of consistency:

The plane of consistency by comparison does not occupy a separate critical distance. It consists of *Haecceities* (which can be thought of as individuations or 'this'nesses). It has no forms, no structures, just relations of movement and rest. Deleuze says it is at one with nature – or at least some understanding of nature that is the same as artifice. This is a plane with no additional conceptual dimension. 'However many dimensions it may have it never has a supplementary dimension to that which transpires upon it' (ibid: 294). Its number of dimensions increase as what happens happens (ibid: 293). This is not how the theory of Panarchy operates, but it is how panarchies themselves seem to operate.

And so if our knowledge is of the plane of consistency, then the methods of this knowing are implicated within what they know. There is no objective distance within ecosophy. There should be no critical distance within a thalassocentric perspective,

just critical implication. Kant's transcendental aesthetic is not thalassocentric, but a Deleuzian plane of consistency is.

Articulated in this way, we can use these ideas of Deleuze and Guattari to read the activity across a number of ‘planes’ in a consistent way. They show the behaviour of systems that animate change and they can be thought of doing so in a marine 'language' of cresting, collapsing and continually combining over many orders. Deterritorialization and reterritorialization fit a thalassocentric, wave centred picture of becoming across many planes. And these movements can only be known when you are among them. When applied to a creative process then this asks how the existence of the apparatus is implicated in the changes in the phenomena that it addresses. In other words when looking at sustainability, does the art apparatus contribute to that issue or undermine it? To what degree is it part of the problem it looks at?

Summary

Arriving at the end of the first section, I now have a set of contexts and tools that can be applied to artwork productively.

We see that Deleuze's way of thinking shares behaviours with movements of the sea. ‘Waves’ or becomings express themselves and collapse over their own varied scales of time. With both the content and process of their work, Deleuze and Guattari have developed and replayed a system of dissolution, flow and intensity. This can (according to De Landa) be interpreted in similar ways to the behaviour of complex systems. The movement of the sea has such complexities, but as I have shown, so does the behaviour of ecosystems, the processes of industrial production, and systems of thought (thought of the individual as well as collective thought, such as social or disciplinary practices).

I can now examine connected presentations of change, looking at emergence and collapse in a range of realms or 'planes'. I can ask what can be known about the plane or planes upon which a work is developed and how it presents or actualises events of emergence and collapse. I can now return to the marine as a starting place for perception.

These perceptions can be applied to arts practice, to review the work of other artists and also to address my own work. And importantly the method of enquiry can just as easily be applied to the materials and processes of the artwork as to the object of its interest. Both the issues addressed by art and the processes of art can be seen as consisting of events of emergence and collapse.

The varied interpretations of apparatus that preceded this chapter can also be related to the insights derived from Deleuzian thought now. An extended apparatus or a thalassocentric apparatus, is an entanglement of material, social and subjective conditions. And the entanglements that make it creative also bring about collapse and emergence in the conditions with which it is connected.

The multidisciplinarity of my approach now makes clearer sense. Accumulating the appropriate elements of an expanded ecology that will develop thalassocentric perspectives is not easy, but this hybrid and creative approach is the best one available. As Latour has noted, 'Neither cybernetics nor hierarchies make it possible to understand the unbalanced, chaotic, Darwinian, sometimes local and sometimes global, sometimes rapid and sometimes slow agents that it brings to light through a multitude of original experimental arrangements, all of which taken together fortunately do not constitute a secure Science' (Latour, 2009: 22).

Part 2

Practice Review of Artworks

Chapter 7: Artworks of Emergence and Collapse

> 'Will the machines run so badly, their component pieces fall apart to such a point that they will return to nothingness and thus allow us to return to nothingness?' Anti-Oedipus (Deleuze Guattari, 1983: 7)

The research has now completed its initial stage and I have assembled the context and critical tools necessary to review other artworks.

I started this research with patterns of movement, drawn after sea swimming and described by different disciplinary practices. I have used these to develop tools to consider collapse and emergence in the connected scales around the sea, which I have termed thalassocentric. I initially asked how we could understand change, connection and scale working alongside each other, but following an introduction to the 'metaphor' of Panarchy, the question changed to include structures in ecologies.

I drew on the work of Deleuze and Guattari. The result was a strengthened figure of waveforms in complex systems, still involving collapse and emergence (or deterritorialization and reterritorialization, which were often *outlandish*. These outlands were found in natural conditions, societal conditions but also the subjective realities of the individual; realms that are dealt with by artists.

Both Panarchy and the work of Deleuze and Guattari described these events in types of intensive conceptual space. For Deleuze and Guattari these waves occurred through a 'plane of immanence'. This plane is not easily separated into distinct territories, but occurs at multiple orders of scale and across different realms (and Guattari's description of the connected realms of environment, psyche and socius is critical here for the expanded notion of ecology I am applying). Supporting this theory, we see (from theories of environmental science) that such oscillations occur in ecosystems as well as other complex systems. Importantly, Deleuzian

thought has shown how the process of enquiry should be included as part of the object of investigation, that is, the method is visibly implicated in the outcome. This will be considered by looking at artworks.

Such division (planes of socius, environment and psyche) and tools (intensive waves of deterritorialization and reterritorialization) helpfully describe forms of ecological knowledge then, but are also suitable for philosophical and creative enquiry. It must be recalled that these systemic, intensive behaviours of emergence and collapse, over multiple connected scales are primarily recognisable from the sea.

To look now at thalassocentric change from a renewed creative position, I will examine artworks that explore collapse or emergence along a plane of one sort or another. I have selected these for the way they reconfigure infrastructures or propose or develop alternative and more sustainable and resilient ways of producing culture and inhabiting spaces. Where possible these practices will address the sea, and other water-based environments, but they are also chosen for their interest in the devices and technologies that enable cultural practice in water and other environments.

Following Guattari's description of ecosophy, I will structure the following selection of practices around the *three ecologies* of environment, psyche and the socius. At times, it will be necessary to turn to artworks more concerned with forms of collapse other than those visible in marine locations.

Tools

I will ask whether and how these works show deterritorialization and reterritorialization as waves of collapse and emergence. And how these waves act and spread through different planes. And I will ask if these works show the agency of non-humans; a form of materiality that has its own emergent and collapsing structures.

Firstly I will address the plane of environment, then the plane of the psyche. When turning to the plane of socius, a review of a programme of marine based environmental workshops (M.A.R.I.N.) shows us that some of the most illustrative

examples of ecological arts practice address what Guattari referred to as the technosphere, its collapse and emergence, ie the contemporary practice of hacking (meaning the break-down and reuse of available resources or equipment in novel ways). This is highly appropriate given the findings from the first part of the thesis. The apparatus becomes a necessary way to navigate these planes. Some, but not many examples of such hacking practices are evident in marine contexts so I will also consider more outlandish hacking practices unconnected with computers or the sea, but which are in some way environmentally orientated. Significantly, such hacking examples again recombine the three realms that Guattari sets out together. They offer different approaches to the devices with which we engage with environment and also suggest reformulation of subjectivities in the face of ecological change. Taken together these three groups of artworks will expand the multiple facets of a Deleuzian plane in such a way that helps us understand ecological change through the *becomings* of the sea.

Plane of Environment

Firstly, I will look at artworks that engage with environment and environmental change in different and relevant ways. Francesca Galleazi undertakes a performance in the northerly frozen sea of the Arctic. She demonstrates hidden chains of causality, implicating the artwork in the problems it comments on. Meanwhile Simon Starling reconfigures and transforms objects around water, so that the artwork emerges to show the systems to which it belongs, and in which it is implicated. I will address one work of his exhibited in TATE's Aquatopia (2013-3014), interpreting it through Deleuze's notion of deterritorialization in a way that describes this work (and those alongside which it was exhibited) on an environmental plane of immanence. I will then address other works by Starling to consolidate this reading.

Galleazzi

As part of a trip to the Arctic with the project Cape Farewell, Francesca Galleazi presented a performance work (*Justifying Bad Behaviour*, 2008) involving the discharge of a cylinder of CO2. She then describes the work on the project website. The Arctic is an outland in a number of senses. Firstly and most obviously, it is a frozen marine environment far from land. It is sparsely habited, and as a result far from most of the concerns and distractions of human social life. It is also one of the

places that show the systemic changes of the planet's climate most starkly. The behaviour of the habitable biosphere is evidently moving away from the predictable or controllable path we might desire. New futures of uncertainty, of multiple collapse and new emerging conditions are visible in Arctic changes; the current outliers of an anthropocene we are moving towards.

Galleazi used the trip to present a work that drew in issues of systemic behaviour - of ice and gas, but also of climate, economics and knowledge generation.

> 'This morning I walked across the fresh snow with a gas cylinder in my arms, containing 6kg of CO2. I took it across the unspoiled snow field of the Jakobshavn Fjord until I found what, to my eyes, was a wonderful place...I walked to the top of the small hill, I put the cylinder down, got on my knees and opened the valve. The CO2 came out violently, freezing the air around the nozzle and producing an unpleasant whistle. When I lowered the cylinder towards the ground, the snow blew off all around me under the pressure of the air jet, almost to signify the melting of the Arctic ice shelf because of the Carbon emissions generated somewhere else.
> Reading this you might think I am an evil horrible woman. I would like to reassure you, I am not! I haven't done anything bad. because I have offset the carbon emissions generated by the CO2 cylinder, through an online Gold Standard Carbon Offsetting scheme! Cool no? This is great stuff. One can go about consciously polluting the world, wasting energy, producing tonnes of waste and abusing natural resources without feeling guilty at all!! One can simply pay somebody to compensate for his/her 'bad' actions somewhere else, and become Carbon Neutral!'
> (Cape Farewell, 2008).

The work was criticised by other artists travelling on the same project. 'Some of my fellow voyagers were upset about my piece because they could visualise that black 'nasty' cylinder full of CO2 in a way that they couldn't, if I told them that every time they drive their car for 30 miles they emit the same amount of carbon dioxide' (ibid).

Perhaps such works of art responding to ecological change should not add to the problem. They should remediate, heal, or nurture. Such psychological gentleness

might be understandable and even badly needed given the multiple acts of damage that constitute contemporary living. But clearly, this work does not heal anything. In fact it causes further damage; intentionally, and it even seems to promote or flaunt this damage. The focus of the work - a 'black “nasty” cylinder full of CO2' is a shocking intervention into the threatened and fragile Arctic. However, this shock is not shock-art that seeks to derive its value from daring discomfort. The shock is not really extreme enough for that. No one is bleeding, nothing really dangerous or unusual is actually happening. At least no more shocking than thousands of daily acts of commuting in thousands of cities. The shock does not come from the action, it is from the realisation of its banality and its significance.

This work is also open to criticism by those that think the responses to climate change, or for that matter other ecological crises should be purely practical. That would be a perspective which locates the material world as quite separate from the world of opinion, imagination, and cultural behaviour. From this perspective, climate change is not only best understood by practices of natural science, but so it follows, also responded to with processes and interventions that follow that model of action; rational action undertaken from an authoritative base of repeatable knowledge acting upon a predictable system. The agents of action in such a response are rational human actors. The system into which they intervene yields to their knowledge in predictable ways. Unexpected outcomes are not central to this model of action. The side-effects of the rational acts undertaken are minimised. The agency of the system itself does not play a significant part; certainly less than the human agency at the centre of this model.

But the open systems with which this work deals, and the system at the heart of ecological change does not work in such predictable ways. We have laid out a thalassocentric perspective of human involvement within a changing connected system that is quite different. It is unpredictable, acting in complex ways through a combination of forces producing outlandish effects. And these forces permeate the whole ‘plane’ – human and non-human, material and psychological.

The work does not heal. It does not shock through an act that is in itself exceptional. It does not offer practical ‘solutions’; what it does do is present process and problem. We are shown the mechanism of a process that is normally invisible. We

are shown –suggested through juxtaposition – a poorly-visualised connection (between carbon dioxide emission and snow in the Arctic). But this jet of CO2 does not melt this patch of snow.
'The snow blow[s] off all around me under the pressure of the air jet, almost to signify the melting of the Arctic ice shelf because of the Carbon emissions generated somewhere else'.

This part of the work is pure theatre. Yet the work is more than this reminder that carbon dioxide impacts in some way upon this snowy landscape. The point is made about the role of offsetting. The (societal and economic) systems which attempt to negate this material process are drawn into the light. So Galleazi does not demonstrate, but merely *evokes* the mechanism of the greenhouse effect. However, she does demonstrate the complex and imperfect systems of society that attempt to respond to that effect, to marketise it, to permit it in certain forms; to subsume and normalise it in our economic processes.
We are shown that climate change is not purely a process of predictable non-human systems that might be understood by natural science. It is political, social, economic and messy. The entire world is living and acting to produce this change and we are entangled in that in many ways. And she shows that climate change is not just caused by distant errant citizens, but by us; by the acts we are engaged in right now. If dirty cities and profit-focussed extraction industries are implicated in unsustainable living, then so in some way are artworks undertaken in the Arctic by large groups of international artists worried about climate change.

So perhaps the most interesting part of this work is how it re-frames the act of knowledge-making itself. An artwork is presented that demonstrates and suggests. Knowledge is produced. But the art causes damage in order for it to work. Helpfully this damage is translated into the more familiar terms of motor travel (30 miles by car) in Galeazzi's discussion on the work. An understanding of the connections between environment and society emerges from an act of damage (we see that Greenhouse Gas management is as much about habits, economics and politics of travel as it is about species and snow). Looking *into* climate entanglement contributed to it. A deterritorialization of atmosphere becomes a reterritorialization of ecosophical knowledge.

Admittedly the scale of this damage does not immediately appear exceptional (it is depressingly common to be implicated in a 30 mile car journey). But have we considered the travel that was involved in the wider trip of which she was part? 46 artists and scientists were part of this trip to the Arctic – one of many. The knowledge they produce may be very beneficial, perhaps critical even, to the process of understanding and responding to ecological change, but that process also contributes in some way to the change.

I do not interpret the point of this work as being criticism of action, research, art or travel. But it does make visible the implications of an extended system of complex causality that joins the non-human world of oceans and ice-bergs with international politics and the personal and cultural sphere. We see a wave of micro damage – an act of decline on the material plane. And this act pulls waves into becoming on psychological and societal planes. The work entangles, or changes our ideas of connection and implication. The result is a form of ecological knowledge rippling outwards to support the emergence of alternative ways of seeing, acting and living. This reconstruction has its cost and that cost is (in part) presented.

What sort of apparatus is it and how does it work? We see a number of different apparatuses at work. Industrial, scientific and artistic. However all are contributing to the detriment of the environment. The artistic apparatus is operating differently here. It contributes to climate change (twice over, once by way of travel, once by way of performance), but makes that visible. As with Deleuze's method, this process is implicated in the presentation.

Simon Starling
Starling is interested in and seeks to show the conditions and processes in cultures at different times and locations. He does this by dismantling things to show the cycles and relationships that underlie them (Kunstmuseum Basel).
This process can be seen as waves of collapse and emergence in materials which read an 'eternal recurrence of the same and still different' (ibid).

Starling's *Infestation Piece*, *Maquette,* 2007, consists of a proposal for sinking a Henry Moore sculpture beneath the waves of a lake. The art is placed outside of human use. This apparent misuse of an artwork addresses environmental

perspectives by exploring the transition from a human-centred to non-human world-view. Whereas once the sculpture might have been picniced besides on a square of manicured grass, it is now beyond the reach of human society; seemingly lost. The sculpture is claimed by an outland that is non-human and (of course) non-terrestrial. The bottom of a lake is beyond normal land. Yet this loss for humans is a gain for non-humans. The cast sculpture becomes a substrate upon which molluscs thrive. We see loss, or collapse, as subjective, dependent upon the point in the network of human and non-human entanglements that you inhabit. What appears to be deterritorialization, might from another position be reterritorialization. In this case it depends if you are a lover of Henry Moore's sculpture or a mollusc. The subjective nature of loss and opportunity is further underlined by the work due to the choice of the particular mollusc species and the location involved. The zebra mussel (which 'infests' the sculpture) was introduced artificially into Lake Ontario, intended site for the full size work, where it has become a dominant species, thriving at the expense of indigenous species.

Fig 25. Infestation Piece, *Maquette,* 2007, Simon Starling

So we see the human perspective displaced towards the perspectives of molluscs. Then even further our empathy is aligned with an invading species rather than an indigenous one. None of these positions is definitive or permanent. The work projects us, fleetingly, into human, native and ‘invading’ identities. All such positions are contingent and face reconfiguration by the vagaries of species movement, economic factors, industry and the acts of artists. The waves of change that move through this work take our subjective positions with them, reconfiguring them into new arrangements and combinations.

A twist of this story sees the focus of interest coming squarely back and becoming human-centred. The full-size work was immersed in Lake Ontario for eighteen months, until a colony of mussels had grown. At that point it was pulled out of the lake and dried out, (presumably killing the mussels) to return the work to a human gallery. Our journey attempting to speculate on perspectives that are wider than immediate human ones comes full circle.

Elsewhere Starling has made works that attempt to fold the process of the artwork in on itself. Autoxylopyrocycloboros (2005), was a restored steam-powered dinghy that was fuelled with its own timber. Planks were cut from the boat as it motored around a lake on a 'circular, entropic voyage' (Covepark.org). As both 'vessel and fuel' (ibid) the work brought about its own collapse by its own realisation. It is a form of *Auto Destructive Art*, as demonstrated by Gustav Metzger in the Destruction in Art Symposium (1966).

Perhaps Starling's best known work takes reconfiguration of material and perception as its central method. Shedboatshed(Mobile Architecture No.2) 2005 is connected to the culture, history and materiality of the location where it was made and where it was exhibited. For this work, created for Kunstmuseum Basel, Starling found a local wooden hut which he transformed into a traditional *Weidling* boat, to float down the Rhine to be exhibited – once more reconfigured back in shed form.

This 'absurd' transportation (Myrone, 2005) is clearly outlandish. It performs deterritorialization of identity, use and location. A wave of destruction and reconstruction has passed through this collection of materials, traditions and usages, but it is only detectable by someone viewing the final installed work through the accompanying story, readable as 'a memory in some traces on the wood's surface' (Kunstmuseum Basel). Starling describes the work as 'operating in the realm of the outmoded or obsolete' (TATE, 2005), signifying this waveform transition as a function of time or ripple of the past.

Collapse and emergence are seen acting together in one way or another. Our perspectives shift when we consider one or the other. A readjustment of perspective is also dealt with in a work that was exhibited alongside Starling's *Infestation Piece* in an exhibition of artworks that address the marine - *Aquatopia* (TATE St.Ives,

2013-2014). The TATE exhibition borrowed an artefact from the collection of the V&A (which describes it as a ‘Shipwreck Ceramic’ (V&A.co.uk)). The V&A tell of the artefact as having been created by a fire on board a Chinese junk in 1725 which fused the ceramics together before it became home to a range of sea creatures. However, in the TATE show, this artefact is described differently and so transformed from a relic of human disaster into a ‘work’ of non-human artistic agency – it is re-labelled ‘Sea Sculpture’. Whereas in a museum it is a historical object of human loss, now in an exhibition where the sea's creative forces of emergence and collapse are under discussion, it is artistic work. The non-human agency of the sea is recognised. The outlandish possibilities of artistic and curatorial disciplines have managed to readjust the artefact to signify the continual collapse and re-emergence taking place around and below human stories. A form of thalassocentrism is possible artistically.

Figure 26. *Shipwreck Ceramic,* © Victoria and Albert Museum, London
Presented as ‘*Sea Sculpture*’ in Aquatopia, TATE St.Ives,

We see the possibility of transformation as central to thalassocentric ecological process, so also key to our understanding of our own agency (and its limits) within what can helpfully be called ‘bigger-than-self' problems (Crompton, 2010: 8). Incompletion, and indeterminacy take on a new significance. Their significance may even be inverted totally in different readings of the same work (pollution is wrong, or it is necessary in order to stop greater pollution. The wood of the boat is contributing

to a greater project – locomotion, or the whole boat is edging closer to collapse). These reconfigurations depend upon which position within an artwork you take as a perspectival starting point. The works encourage a movement of positions. Our perception transforms as the work transforms.
We are not put at the centre of these systems, but bumped around them. Matter is broken-down and reshaped, moved or reused. Transformation is occurring in the material plane. It also occurs in our perception.

The above works are made by humans, but their behaviour shows us the 'becomings' of the complex systems (human and non-human) of which they are part; systems with their own agency. Galleazi shows us the system of economics, politics and climate. Starling shows us the system of culture, location and historical artefacts. They recognise the emergent behaviour of political and economic systems in expanded ecological ways.

Plane of Psyche

'Specific to mental ecology is the principle that its approach to existential territories derives from a pre-objectal and pre-personal logic...in which black and white are indistinct, in which the beautiful coexists with the ugly, the inside with the outside, the 'good' object with the bad' (Guattari, 2005: 140-141).

Tacita Dean and Bas Jan Ader address collapse at sea in ways that put particular importance on what I frame here as the plane of psyche. I will show the works present *becomings* realised through forms of emergence, reconfiguration and often collapse. These becomings will be considered as waves on the plane of psyche. I will also show that this collapse connects with or is articulated through other planes as well.

Connections between personal narratives (including those of the people that are the subject of the artworks and the lives of the artists who make the work) will become readable as a propagating series of events. And these waves of becoming connect and resonate. We see crests and troughs of obsession connecting individuals at the centre of this work and ripples of influence felt in the work of other practitioners (in the influence of JG Ballard and Robert Smithson and the more recent work of Amy Sharrocks). Within the work we see connected currents of becoming

(deterritorialization and reterritorialization) reconfiguring subject, material and other intensities and spreading into a wider hinterland which contextualises changing practices of media use, industrial infrastructure and audience habit.

Tacita Dean

Many of the works of Tacita Dean address the sea directly. *The Wrecking of the Ngahere* (2001), photo-etching on paper, shows a ship on the point of being lost. Written on the work are the words: 'Rock'; 'Rough Sea'; 'fickle waters'; 'white water aboard'; 'water onboard'; 'black mass'; 'the sea's got her now - bye bye'; 'End' (underlined twice). We are presented with a clear story of loss; of life and property. A familiar, tragic narrative perhaps. The work is one of a series of works, collectively entitled '*The Russian Ending*', a title which refers to the practice from the early twentieth century Danish film industry, whereby films were made with both a happy ending (the American and British one), and one for a Russian audience which ends in tragedy (Tate). Control is lost by people who play out a Russian Ending. In a Russian ending it is asserted by other forces.

Other works, such as *Roaring 40s, Seven Drawings in Seven Days* (1997) also show scenes of loss, tragedy and collapse at sea. These chalk drawings executed on blackboard show images of the high seas, square-rigged tall ships from the age of sail (a byegone or lost chapter in seafaring) and sailors caught in perilous acts (pulling in a sail in high wind, while dangling from rope).

Dean's interest in presenting such collapse is worked through on multiple levels. The personal stories and socio-economic history are of decline, but the medium is also chosen for the same reasons. The chalk drawings of the *Roaring 40s* series are themselves fragile; easily erased with the swipe of a damp cloth, or mark of a thumb. They emerged in the period of seven days described in their title, and this ephemerality underlines how they will eventually pass into non-existence once more. The medium of chalk on board is also somewhat historical, or anachronistic. You get a clear sense of a process of change whereby an empty board passes into a drawn stage. Then at some indeterminate point in the future this null state will be returned to again. The precarity of (their) existence is part of what they show; a wave of becoming frozen at its teetering peak. And at that peak we see the same precarity; flux, emergence and dissolution also presented through life and loss at

sea. The sailor is not lost – yet. The ship does not sink – yet. But the emergent half of the process is set up tantalisingly, symmetrically faced down by the possibility, indeed the certainty of these drawings' collapse and these lives that have waned too.

Likewise, the photo etchings of *The Russian Ending* refer to past practices in the film industry. The descriptions written on the image evoke film direction for a cast and production that we will never see (TATE). The films of the early twentieth century are evoked as a resonating figure of loss. Our tools for perceiving and representing this collapse are also undergoing collapse. Just as the Ngahere is caught in passing, on its way below waves it once crossed, so we see the silent film industry lost beneath waves of other intensities (of new yet also ephemeral technologies) and feel the passing current of celluloid in all its forms (this interest in using artistic medium to present the decline of the medium itself is later explored in Dean's 2006 work, *Kodak*, where she uses obsolete film stock to film the Kodak factory which will no longer produce that stock).

The sea is used as a figure of overwhelming destruction of property and of identity. These works set up resonances between similar processes, played out across different levels. A ship sinks, an industry sinks. Waves roll past, as (or in) receding lives, and changing materials. The works are poised amidst a process of emergence and (their own) collapse, and we see that this process, while pointing firstly to a personal, or psychological sense of tragedy, also passes through industrial issues, and bleeds (or deterritorializes) from the societal and the natural.

Closely connected with her interests are the stories of Donald Crowhurst (a sailor) and the artist Bas Jan Ader. Both men were lost at sea after undertaking extreme voyages. Their stories resonate too, across interests and between personal circumstances. Dean's work addresses the story of Crowhurst in detail, a sailor whose ambition led him to falsify his travels, ultimately ending in his presumed suicide at sea. (*Teignmouth Electron*, 2013; *Disappearance at Sea*, 1996). Here the loss is personal and individual.

Her work is claimed to address relationships between the real and the unreal. We see maps and spaces of reality, as well as seeing territories of unreality and the

misfits between these two mappings (Townsend, 2001). Following this interpretation we are presented with the 'fallibility, and ‘fantasy' of Crowhurst’s escape, failure and ultimately his suicide. This is a picture of humanity 'at the mercy of a capricious and cruel destiny' (Townsend, 2001).

But the tensions of this story are also between emergence, growth and the forces of dissipation and entropy and these forces resurface again and again. This is not unreality. These are real forces, but they are intensive. They animate the behaviour of mind and sense of self as much as extensive and visible materials. These collapses, dissipations and connections are not about misfits of perception. They are not about schisms. There is a continuity in what is presented.

Dean is also interested in the role of time; acts that stand within time, but that also present time and its actions from different vantage points. This fits with a reading of deterritorialization as a form of collapse across different realms and intensities. It is a socio-cultural reality, but also one that is individual and a reality that is environmental. These are forms of temporal reality.

Dean cites JG Ballard as an influence. Ballard was the author of *Drowned World* which imagined a planet made uninhabitable by global warming and sea rise, as well as other works that resonate to a generation who spent their childhoods in 'newly built cityscapes already in decline' (Dean, 2009).

'My interest in time, cosmic and human, future and past, as well as the analogue spooling of the now, has Ballard at its core' (ibid). She observed of Ballard that 'He was a man of his time, but also stood apart from it. ' with an interest, like her, in temporal becomings, played out in different scales, registers or *planes*.
'Ballard gave us the aesthetic language of entropy, one particular to the civic space, motorway or industrial complex ' This entropy is a material reality. It is intensive, an animating 'dark precursor', one of the fundamental laws of thermodynamics. And we see this intensive reality evoked in an environmentally framed reading of social spaces. In particular the spaces of the 'industrial complex'. The work presents intensive forces that drive basic material change. The same forces animate psychic or deeply personal events and also are shown to be operating within declining technology.

Bas Jan Ader

Dean also comments on Ader who was lost at sea during a performance artwork *In Search of the Miraculous (1975)*. I will consider this work after first looking at Ader's earlier works.

Ader's earlier works are about falling, collapse and forms of emergence, and while they do not take place around the sea, these 'becomings' are also influential and relevant. They also involve water at times. On one level these works of falling are very explicitly concerned with the most prosaic form of (extensive) collapse; that of objects in space which fall due to gravity. His films show 'fallings' from roofs, from trees and from pavements into waterways (*Fall I, Broken Fall (organic), Fall II,* 1970). The physical mass of the artist demonstrates this most inescapable and universal force (or *dark precursor*), which on a very basic and very real level animates the most familiar plane of immanence. A falling is a becoming.

More recently, Amy Sharrocks has continued and extended some of the themes addressed by Ader linking falling and water (Swim (2007); *Season for Falling; an Invitation to Fall; A Time to Fall* (2012); *Museum of Water* (2014)). Works such as *SWIM* (2007), invited 50 people to 'swim across London' (Artsadmin) through a series of visits to public pools and lidos. Most recently Sharrocks has invited contributions for a '*Museum of Water* (2014), which included public comments describing personal, social significance of water as part of exhibits. Water is again a site for exploring types of collapse or deterritorialization. Her work is described as engaging with a sense of 'risk' (Royal British Sculptors). Through this 'physical and conceptual falling' participants experience a safe or manageable exploration of challenging ideas linked to shame, pain, inelegance, loss of control, a sense of insecurity (ibid).

Falling is a form of becoming; a deterritorialization of space and of types of identity or control. This is recognised and developed by Sharrocks and strongly associated with fluidity. From both Ader and Sharrocks, we see that falling, aside from an empty act of abandonment, becomes an action, initiated by the artist, but realised through forces that are not human, not animal, but rather that exist, animate and dissipate the world; becoming part of such an action, inviting it, allows a participant to become

part of this plane of immanence and to experience it. Interestingly, both artists choose to fall into water at times. Sharrock's *Season for Falling* invites participants to fall in different locations, including Kings Road, London but also the sea at Aberystwyth. Sharrocks says that falling allows people to experience ' Flying, freedom' (Artsadmin). A new aspect of being is realised.

Rather than ending the action with hard impact, which would draw attention to the solidity of the earth, this landing (or perhaps 'outlanding'), continues the movement of decline into water. The works segue into different types of oscillation (bobbing, sinking, or thrashing about perhaps), even though this end of the work is only suggested and not documented.

And this relation, a development from falling towards the marine environment is traced in the final work of Ader's career. *In Search of the Miraculous* (1975) transformed flight and movement from the simple vertical drop to a different plane, that of the nautical and the personal. For this final, tragic (and highly influential) work, Ader set out from America on a trans-Atlantic voyage in an unfeasibly tiny craft and never arrived in Europe. In the film exploring Ader's disappearance, *Here Is Always Somewhere Else* (2007), Dean appears and highlights the fact that Ader was carrying a copy of a book about Crowhurst on his journey. This fact suggests that these human trajectories connect, or perhaps precipitate further collapse on a more intensive plane. We see personal trajectories rise... and fall, encouraged by others with a sympathetic path. And these paths do not necessarily overlap in obvious ways. They may not be extensive (eg material or concerning the sea), but falling in space, into water, into a personal journey of discovery and through loss, is perhaps a deterritorialization or reterritorialization on an intensive plane of 'psyche' as described by Guattari, or the transmission of collapsing and emerging Panarchies connected in personal life and artistic practices. In this sense, extensive can be thought of as an immediate and visible truth that you can rap your knuckles on, rather than the intensive reality that animates the world in partially understood and apparently miraculous ways.

Director of the film, Rene Daalder, comments: 'All Bas Jan had to do was to take to the ocean and participate in the truth. But Bas Jan was not just searching for the truth, he was searching for the miraculous, his [physicist] mother's universe where

matter is not really matter, but invisible galaxies of ions and electrons. Crowhurst's immaterial world of cosmic beings...' (Daalder, 2007). This truth is a non-human truth in which the human sits. Apparently miraculous, but no less real for that. Mental states and meteorological conditions connect and pass through each other, entangled in their shared behaviour which demonstrates its own systemic life.

Plane of Socius

'More than ever today, nature has become inseparable from culture; and if we are to understand the interactions between ecosystems, the mechanosphere, and the social and individual universes of reference, we have to learn to think 'transversally' (Guattari, 2005: 135).

Following on from the two ecologies addressed previously would lead now to a discussion and suitable examples of artwork that address social ecologies. However the examples I discuss are increasingly bringing additional concerns into play. I have shown how, when selecting works that operate within mental and environmental ecologies, these designations are useful starting points, but that they do not offer impassable limits or clear bound for such discussions. Instead I have shown the environmental to be entangled with the mental, and the social and the mental ecologies to be animated by environmental effects. Artwork, its technologies and traditions is becoming a particularly illustrative vector along which these entanglements can be traced.

Continuing the discussion of collapse and emergence, I turn to projects that are socially framed. Here the technical materials become an even more central device around which the practices are developed and deployed (within what Guattari called the techno-sphere). I will show this with practices that utilise 'hacking[xxiii]' methodologies, since they are particularly useful when looking at the techno-sphere's material entanglement of environment, psyche and socius and the collapsing and reformation that takes place across these interlinked realms. The collapse and reformation that constitutes hacking is also highly relevant as found from the previous chapter looking at emergence and collapse in Deleuzian terms.

Guattari and hacking practices as transverse ecologies.

In Three Ecologies, Guattari says social ecologies should shift into a 'post media

age' of reappropriation (Guattari, 2005: 144). He points to possibilities within unlikely, or outlandish uses and missuses of technology. In particular he cites mass movements of awareness and new social movements, (apparently anticipating social media) a significant aspect of hacker and new media culture. He also advocates different uses and new possibilities for mass media technology, pointing to declining costs and increased prevalence of technology (ibid: 144). A 'creationist' subjectivity could make itself through its own production, involving training, swapping of skills and different types of participant in the face of industrial obsolescence (ibid: 144). This very prescient description offers an appropriate definition of hacker culture, which is later progressed in Deleuzian terms by McKenzie Wark (see below), but also shares many similarities with the idea of bricolage that was developed by Claude Levi-Strauss[xxiv].

I start with an example that encourages and exchanges methods of artistic enquiry at sea (M.A.R.I.N.). After contrasting this relatively tightly-framed technical hack with Heath Bunting's more outlandish social hacking, I will turn to two examples of environmentally-framed technological hacking projects. These address and reconfigure industrial and social infrastructures (looking at a common domestic toaster and personal computers). They also pay close attention to the means of their production in ways that is relevant for art production. These latter examples which do not address the sea will offer additional insight into how processes of social exchange and reconfiguration of art process can be brought to bear on marine artworks.

Hacking as an artistic practice

'Hacking' is an artistic practice easily described in terms of reconfiguration, breakdown and emergence of new forms. Theorist of hacking culture, McKenzie Wark, espouses ideas that share much with Deleuze and Guattari. In *A Hacker Manifesto* (2004), Wark describes property as 'an abstract plane' (Wark, 2004: 7). Hacking of any sort whether in computer process or cultural forms is said to create 'the possibility of new things entering the world' (ibid: 02). We see that *new* is a value free judgement and new things might be good or bad. This is similar to the reconfiguration of perspective we encountered in Starling's artwork and the ambivalence of positive and negative deterritorialization.

We also see that the hacked apparatus brings to light entanglements between subject and object, in line with Guattari's objection to Cartesian separation '...To hack is to trouble the object or the subject, by transforming in some way the very process of production by which objects and subjects come into being and recognise each other by their representations.' (ibid: 46). Wark's interpretation of hacking presents it as an immanent process; it performs a production that makes new things and changes or makes the producer as well. The infrastructure of production is reconfigured in some way. 'Production produces not only the object of the production process, but also the producer as subject… every hacker is at one and the same time producer and product of the hack' (ibid: 8). This emphasises the importance of the social context in which producers sit and in which they distribute the outcome of their hack. It also clearly makes the point of process and product both being within the same conceptual space.

Hacking as a social wave.

The similarities between hacking and the Deleuzian interpretation of wave are readily found. In its reconfiguration of material and mental relations we see hacking as a social ecology. I will move on to discuss examples of practices that hack at sea, hack social relations and those that hack other technological infrastructures and which show the dependency of hacking on its social configuration. I will show that hacking has a dependency upon social infrastructures in that it often requires processes of open sharing and the strong participation of ever-shifting groups in order to happen and to perpetuate.

M.A.R.I.N.

M.A.R.I.N. Media Art Research Interdisciplinary Network (2009-2011) is a strand of projects of production and sharing taking place on board a yacht. It aims to facilitate 'Research and collaboration between arts and sciences with a focus on environmental computing and marine ecologies'

The process and residencies at the heart of this project (Sensing the Baltic Sea (June 1st-30th 2011) and Cartography of the Everyday at Sea (August 1st-31st, 2011)), used wind, solar power and open source technologies. This is an environmental approach that necessarily includes ways of working as part of its investigation in addition to the artworks that result. The connected description of

apparatus developed above would include the yacht the project uses too. The open source (and cross-disciplinary) aims also seek to produce outcomes that are shared and a method that can be copied and improved on too. It deploys a social ecology to address location, research infrastructure and the production and exchange of knowledge.

Initial residencies concerned ‘Marine environments, sustainable mobility, and various methods & technologies for field work.’ Work produced included (among other things) a database with GPS coordinates for wild apples in an island on part of the boat's research route; locative media apps exploring agriculture and ecology; geo-tagged information to create a location-based, immersive sound installation; a solar-powered buoy that measures water temperature and displays it as 'semaphore' (Karelse, 2011; Rosner, 2011; EcoLocated, 2009; Tammepää 2011).

The approaches favoured are clearly set out (open source[xxv]), but the results are not. So the project is primarily about producing a context for a type of work while remaining open to particular results and outcomes. Artists found themselves 'thinking as scientist, interpreter and citizen'...[then incorporating] 'all roles in the process of figuring out how to respond' (M.A.R.I.N., 2001)

The work made scientific measurement available to artistic tactics, materials and presentation, while seemingly remaining largely scientific in its aims. The project centres on the need to extend the reach of knowledge for environmental issues. It is concerned with apparatuses and their use.

Significance of the apparatus

The role of the extended apparatus, including the yacht, is discussed at length on the project website (http://marin.cc). Such a dependency upon technology risks setting up a hierarchy based on how advanced the technology used is. As part of the yacht's journey, it visited the British Oceanographic Data Centre, and the Proudman Oceanographic Laboratory to talk to scientists about the ' latest sea bed velocity sensors'. There the artists recount how they saw equipment that 'makes our water measurement equipment seem like kids play' (ibid). Accepting this primacy of costly equipment over artistic methods and approaches would lead to a state where the greatest economic investment could result in the most apparently authoritative

artwork. This would become exclusive, dependent upon high energy flows as well as marginalising for artistic practices in comparison with science and marginalising for outlandish voices and perceptions that I propose are so valuable.

And the apparatus as the heart of this project has other problems. 'In 2009 we discovered that sailing consumes far more energy and time from the actual research than we had anticipated. The boat would need to be much bigger to enable efficient work and living on board for more than five people' (ibid).

While the approach of M.A.R.I.N. offers a critical and productive way of considering art production as environmental in output and impact, this develops costly dependencies on new infrastructure (through commissioning and operating), and the level of infrastructure available to artistic practices is much less than for scientific investments. Compared on scientific terms, artistic outputs do not reach as far in time or space as scientific instruments do and they can still distract artists from producing art much of the time. The role of the apparatus is both facilitating and problematic then, showing connections but adding costs (in time, energy, exclusivity) and positions arts practice as a lesser form of science. Again, many of these issues are derived from the wish to remove the yacht and low-cost approaches of arts practice from view. If instead, these were made central, then the outputs would be able to talk about these issues in productive ways rather than see them as a distraction.

Social hacking

When considering environmental change and the potential for collapse and emergence which might accompany M.A.R.I.N.'s reconfigurations, its hacks are focussed compared to other works. The works of Heath Bunting reconfigure wider conditions by comparison. They imagine the urban landscape as a new wilderness,

Avon Gorge Wild Swim Race 2009, Bristol, United Kingdom (UK) seeks to disrupt and reconfigure (ie collapse and rearrange) existing social orders through different events and activities within urban and semi-urban space. A previously unlikely activity for a particular location – swimming below the industrially forbidding and heavily managed Clifton Suspension Bridge – is proposed. This newly configured way of using a location leads to the discovery and temporary habitation of a new

non-human space within city confines. This non-human space or ‘outland’ is arrived at by psychological and social reconfiguration, not by distant travel or by technology.

Many collaborators and participants joined in with this quasi-celebratory artwork which remixes sport and survivalism. A list of management agencies for the Avon Gorge are listed within the documentation of Bunting's work, describing the entanglements in the space and its use. We are also told that 'Over 50 spectators, including Avon and Somerset Police and Fire Brigade, witnessed the race ', we are left to wonder about the role that the emergency services thought they were fulfilling and how the artist has recast them as spectators. Were they in on the joke? Roles are loosened, relations between terrain, human and non-human reconfigured.

In another work, *Prepare For Death*, (2005) the artist speculates on the total collapse that ultimately overtake every individual. This workshop is:

> ‘A “how to” in preparing for ones own death. The practical and physiological process of disappearance. From utility disconnection to maximisation of life opportunities. The event will take place at the Brunel Buttery, Bristol so there will be an opportunity to snack on chip butty and discuss’ (Irational, 2005).

The point of including this form of social hacking, again addressing forms of personal collapse or being immersed in water is to underline the extent to which changes can be wrought upon existing infrastructures, when reconsidering radical (social) ecologies. Following Deleuze and Guattari we again see these infrastructures as including the material and technical, but also inextricably involving social relations and formulations of subjectivity.

Two last two examples of artworks in this section are *The Toaster Project* and the *Zero Dollar Laptop* (*ZDL*) project. These works contribute to a social and ecological critique of infrastructure dependencies without considering the marine. However, their deterritorializations and reterritorializations can be seen as necessary extensions of the thalassocentric reading developed already and they offer useful insight into possible apparatuses. They also use hacking to explore other understandings of sustainability and unsustainability. The methods explore how people who have no infrastructure could DIY - do it themselves (or 'DIWO' – Do it

With Others in the case of *ZDL*, (Furtherfield)); an approach that is resourceful, but, as I will show still has limits.

ZDL looks at the access to, and use of, technology through the skills and social cost of hardware, using open source methods to make creative IT tools for people with little other resources. These users may then make art with the IT equipment or use it for other purposes. *The Toaster Project* looks beyond the computer and addresses even more common processes and outputs of mass production, attempting to replicate these processes with small scale, readily-available skills and materials. The result is an absurdist and elaborate, super-costly reconstruction of a kitchen appliance that highlights the possibility and limits to doing-it-yourself, as well as the inescapable extent of industrial processes, their scope and the hidden costs behind even the most innocuous of objects. These works will show that practices of social ecology - whether in the sea or not - cluster along tools and devices, and depend upon them and reshape them to make wider infrastructures of production and emergence evident. Yet they never escape dependency upon other infrastructures.

The Toaster Project

The Toaster Project by Thomas Thwaites was a speculative project that followed a line of thinking towards an absurd conclusion. It attempted to construct a familiar domestic toaster – normally available for a few pounds in high street shops – 'from the ground up' (Thwaites, 2014), ie without the use of the industrial infrastructure and ready-made materials that we normally rely on in many unseen ways.

The work imagines the absence of (ie collapses) a wider industrial infrastructure, and powerfully works through the implications of that by attempting to replace this infrastructure with homespun methods (a form of emergence). It owes much to ideas of self-sufficiency and to cultural narratives of collapse[xxvi].

In the face of societal and technological uncertainty, a hacking approach to self-sufficiency is often presented as resilient. 'Repair is independence' encourages the Self-repair manifesto of iFixit. ‘If you can't mend it you don't own it' (iFixit). These approaches lessen dependence upon producers and their network of repair, replacement and obsolescence, putting repair skills into the hands of owners. iFixit's

goal is to build a self-repair manual for every device. Other projects such as the Global Village Construction Set (an open source manual for building a ‘Civilization Starter Kit’) also aim to make forms of advanced technology available as a response to the prospect of wider societal decline. While these projects increase resilience within socio-technical entanglements, the true extent of social dependence on hidden infrastructures is still hard to conceive.

The Toaster Project (Thwaites 2007), traces hidden or overlooked infrastructures and skills behind the production of the most common of industrially-produced machines. The collapse, or removal of the infrastructure that makes such toasters available so cheaply (removed in this instance by an act of imagination) is examined more easily though the trials of attempting to replace it.

Attempting to read these forms of production as a wave might consider how systems I have discussed previously involve many levels of oscillations on top of each other. In this case, Thwaites' particular artefact – a toaster – is like a ripple sitting on top of a wave, on top of a swell. It is hard to see how that ripple could be realised without the many levels of movement and reshaping that it sits upon. Thwaites' project explores this at length. The process of making the toaster 'from scratch' involves many levels of production and dependence upon many layers of infrastructure. Thwaites undertook lots of travel, research and failure. After an extended period of research, he manages to locate iron ore which he collects in a suitcase, from a mine he visited by train. He attempts to smelt it in a microwave. This fails. He then constructs a furnace from junk; just one among many elaborate processes he follows (including the production and winding of copper for the element). Ultimately, a complex and costly toaster is produced.

But Thwaites himself acknowledges the impossibility of his project‘s aim of self-sufficiency (Thwaites, 2014). Again and again he is forced to ignore or discount the infrastructure he uses. He excludes the train he uses to visit the mine where the ore is found as well as the pre-existence of the mine itself. Likewise the processes, investments and energy represented by the presence of the microwave he uses to try to smelt the ore is outside the scope of 'starting from scratch'. Underneath every construction or declining technology, there is another. The work shows the multiple scales of the techno-social plane.

Part of his point is this absurdity. He shows that you can’t do it all yourself, or, making the same point in terms of changing times, you can't go ‘back’. Quoting a geologist to demonstrate the impossibility of any kind of return to previous historical conditions he observes 'You couldn't have [another] bronze age...50% copper [ore] doesn't exist anymore' (Thwaites, 2014). This is not a narrative of pure building or pure collapse. At each point of contact between the project and the infrastructures in which it is made Thwaites has to draw a line or boundary to decide where ’ground up’ can start from. But this boundary is arbitrary and contingent. It is also inextricable from history and will collapse or emerge in some ways easier than others.

Collapse can never be a return all the way 'to the ground' to start again. He (we) cannot go *back* to before an industrial system. In other words, when viewed on a timeline, the collapse and reconfiguration of this system cannot be symmetrical to its history of emergence. A simple return to historical models is not possible, even if elements from different times can be made and included in sustainable futures. Material manifestations of technology are entangled with the infrastructures that have produced them over time. In this sense the infrastructures themselves can be seen as a wave in time, emerging and declining, but not symmetrical and regular waves.

While some narratives of collapse appear to call for or strengthen a lone individual as a solution to unsustainability, Thwaites' toaster is 'a clear repudiation that you can make all your own stuff' (Thwaites, 2014). He concludes self reliance is unlikely. We still depend on so many things that are beyond our own personal abilities. Guattari agrees with this wavelike temporality: 'Neither human work nor the natural habitat can return, even to their state of being of a few decades ago.' (Guattari, 2005: 134).

Zero Dollar Laptop

Zero Dollar Laptop (2011-2013) is a project initiated by Access Space, a community-based art and media lab influenced by the Free and Open Source Software (FOSS) movement and thoroughly grounded in hacker culture. It was delivered in partnership with London-based art and activism organisation

Furtherfield. Access Space has a background in taking discarded computers and teaching people hacking techniques to reconfigure them into a free-to-use, cheap-to-set-up, media lab. They worked with Furtherfield to apply their methods to laptops. *ZDL* focusses on the social component of technology, its relations, embedded knowledge and distributed memory. Accordingly, the project's approach to cultural production becomes fundamentally collaborative and built on social relations. It has an explicit aim of dynamic self perpetuation – an ever changing form of socially embedded technology. The skills involved are as much part of the project as the finished device. This approach (initially developed for medialabs by Access Space) is extended by this project to produce cheap, or free, laptops that anyone can access. The artist groups show us that to consider ecological knowledge we will have to consider the role, impact and extent of the devices - the apparatus - that make the work, and that is largely a social question.

Access Space acquire discarded or obsolete machines for use in projects such as *ZDL*. These machines often work perfectly, despite being given away for free. They have no commercial value within current economic arrangements yet they are easily made useful. In fact, previous users will often pay to get them taken away since 'Only a highly specified PC will run the latest version of Windows' (Wallbank, 2008: 49). The machines are reconfigured in workshops using the open sharing of skills. Access Space criticize society’s commitment to the newest proprietary hard and software. As well as resulting in more e-waste it has other problems. 'Viruses remain a constant problem' (ibid: 49), and the costs associated with software licences and new hardware means 'most of the budget goes on technology not people'. This re-use and re-socialising is presented as an appropriate response to unsustainable living. 'I foreground re-use over recycling, dealing with redundant or obsolete technology…The carbon footprint of the zero dollar laptop is zero' (ZDL Manifesto). Re-purposed, these machines end up as low cost devices for art production. The project offers alternative models to an unsustainable system of consumption, production, in-built obsolescence, disempowerment and waste. It rejects a dependence upon high-cost economic approaches as unsustainable. This social ecology shows us that the techno-sphere extends to structures of economy and social perceptions of value and their embodiment in consumer products.

The structures of money and time that are part of ‘normal’ computer use are also

pulled apart and reassembled by Access Space. They are interested in investing time, not money and gaining skills, not hardware. 'You may be reluctant to invest time, of which you may only have a little, rather than invest money - of which you may have plenty. Think about the longer-term consequences: buy software and you'll have to pay again and again. Invest time learning about free software, and you'll never have to pay for software again' (ZDL manifesto).

A new arrangement of time, skills and other resources is proposed in the place of the normal approach to growth and technological dependence. Instead the project is dependent upon collectives and groups, often from previously marginalised communities. This approach acknowledges the brittleness of hard infrastructures and the socio-cultural constitution of the apparatus. This is not self-sufficiency in its extreme form. The sufficient 'self' is not a lone individual, but rather a collective.

The *ZDL* apparatus (including its social, environmental and techno-material aspect) changes the world and itself in use. This agrees with our reading of social ecology as one aspect of a plane of immanence that is entangled with other orders of becoming.
But the replacement computers Furtherfield and Access Space make are not intrinsically more robust than the infrastructure they oppose. They manage a different set of fragilities. Skills, time and community build a new resilience in this new model, but the very existence of the model, its dissemination as an idea - is still dependent on techno-industrial infrastructure of a free, open, functioning and accessible internet. If hacks are not shared, they die. An Online video explaining about the *ZDL* project – and such dissemination is an essential part of its shared, open source existence - is as subject to collapse as the core hardware it attempts to replace or underpin.

When attempting to access this video through the online file sharing service Vimeo, it was unavailable because of a malicious web attack[xxvii]. A new infrastructure is shown to be brittle and subject to collapse. Our choice of dependencies are contingent.

Summary

This section set out to describe waves of becoming comprising deterritorialization and reterritorialization on the plane of immanence. This was done using artworks chosen and initially categorised around Guattari's three ecologies. By interpreting Deleuze's idea of deterritorialization as a form or wave of outlandishness, we have more easily seen these works as acts of emergence and/or collapse on different connected planes of immanence.

The works show changes that can be understood as complex. Changes in small details (such the environmental impact of artworks) are connected to changes that are larger (conditions of the anthropocene). Importantly, changes between apparently different realities are shown to connect (for instance human stories and minds and the destructive drive of the sea).

The role of apparatuses was explored in almost all of these works (with perhaps the exception of Bunting, Sharrocks and Bas Jan Ader, and even then, Ader's apparatus could be thought of as his own body and life). These apparatuses showed the changes of the world and changes of social understanding for Galleazi. They showed their capabilities of reformation and self-consumption for Starling.

Types of hacking were an important feature of many of these works. Furtherfield, Access Space and M.A.R.I.N. addressed how creative apparatuses could be made available in ways of open sharing. For Bunting the social sharing was about behaviours and perceptions and the hacking was of these same things. For all of the artists concerned with hacking, the apparatus was a social empowerment that allowed understanding of marine environments (M.A.R.I.N.), or creative possibilities (Furtherfield and Access Space, Bunting). For Thwaites the apparatus showed how connected and dependent it was on existing processes of industrial manufacture (as, by extension are we), while others sought to limit or readdress those dependencies.

The apparatus was shown to be a tool through which the complex changes of socius, psyche and environment moved and connected. At times these types of intensive shape could be perceived (as with the material reformations of Starling) although in most of the cases these intensive shapes were not the primary concern

of the work.

The role of the apparatus in M.A.R.I.N. was of interest in that the hacks and works of the artists were focussed upon, but the cost (in terms of time) of using the yacht was seen as a distraction, rather than a part of the artwork. In this sense this project operated a scientific division between what it addressed and what it sought to make irrelevant or less visible.

Having constructed and used the critical tools to select and understand these works, I have shown how, together, they describe a field of knowledge production that is open and shareable, but that addresses connected conditions of change on many levels (including in the planes described by Guattari as psyche, socius and environment). This is the practice context in which the final works I produce are to be understood.

Part 3

Original Artworks That Result in a Thalassocentric Apparatus

Chapter 8 Hydrohacks and their Documentation

I have discussed the problem of the sea, exploring how a sea-centred perspective can be refined and applied through other connected ‘plane/s’. I have tested these approaches in my own earlier artworks and found the role of the reconfigured and reconfiguring art apparatus is of central importance.

When attempting to show the complex movements such as those seen around the sea, I have previously described artworks that have opened up and tested different aspects of a thalassocentric perspective. The drawings discussed in Chapter 2 dealt with the extensive behaviour of the sea; its movement over many scales. Artworks using piles of sand looked at shapes and movements of emergent structure and collapse within the material world. The performance I discussed previously demonstrated how processes of emergence and collapse constitute waves in water, as sound and in technologies, including the apparatuses used by artists. These works have shown emergence and collapse in the material world at different points, including technological arrangements of equipment, non-human materials (such as sand) and in social and subjective conditions as well.

The critical perspectives and resources I have brought to bear on these researches have been chosen to *diffract* the knowledge against the arts practice that drives this research. As described above, I have undertaken this diffraction following Barad's method of using one form of knowledge to understand another at the same time as it, itself, is changed by that use. This has produced a theoretical approach that has been shaped by artistic practice and that supports and guides artistic production. A conceptual space is produced that might be exploited by artworks. This conceptual space includes the producer and their process. It consists of intensive becomings, or waves in human and non-human processes. They emerge or collapse, variably.

These ideas are now brought to fruition through the production (and comment on) a final set of artworks undertaken as research. They will seek to trace the extent of the apparatus and its impact and include the documentation as part of the artworks (as highlighted by other hacking approaches discussed above). I will conclude with a detailed discussion informed by these works that combine the themes discussed.

Artworks

The works I produced and describe here function as a set of devices for marine research. They include cameras and hydrophones and, significantly, a kayak. I termed them *Hydrohacks*. All are made from discarded or redundant materials of some form or another. Their production is presented as a process of collapse, reconfiguration, sharing and connection that draws together the strands discussed so far. These works consider their environmental impact and look at the significance of reducing this impact. In terms developed in previous chapters, we can say they depend upon and demonstrate movements and change on social planes. This is undertaken using approaches from hacker culture which inform their production and disseminated.

When considering these works as *thalassocentric apparatuses* I will see that the knowledge they produce is derived from along the length of their entanglements. By this I mean the way that society, environment and psyche are connected and changed by the works in different ways and at different scales or levels. This contrasts with knowledge from other (for instance, scientific) apparatuses that might make separate 'objective' knowledge. These types of apparatus are thought of as distinct from their context of production and the individuals who produce and interpret them when they are deployed.

And while knowledge is produced from along these apparatuses, we find that we can never trace their entire length or determine their boundary. Using the tools I have developed in this thesis allows me to look at the impact of the knowledge, its emergence, growth and dissemination. This shows that new connections and ripples of impact continue endlessly. I will show that through their length and towards their limits these apparatuses mingle and combine with many other waves. A thalassocentric context helps make sense of this pattern of change and connection.

The documentation of the work shows a form of emergence and collapse itself. We see the art apparatus that seeks to find the sea does so by showing the movements and becomings of the sea that are present in its own becoming.

Hydrohacks

Hydrohacks were a collection of works produced through hacking. As acts, these works all performed some form of collapse. They used existing materials and resources and broke down and combined them in novel ways to give rise to new arrangements and objects.

The works constituted a suite of apparatuses for undertaking forms of ‘research’ in the sea. including hydrophones, cameras and a sea kayak. The materials and processes were low cost, low impact and accessible. This meant that the works were easy to make and so could easily be remade (by me, or others), without the use of highly specialised materials or tools. They could also be made in slightly different ways, making use of changing availability in materials and tools. This represented an approach that could easily adapt to unexpected changes or shocks in the wider system of industrial production (which more ‘professional’ equipment is more closely dependent upon). The works propose art as a form of resilient knowledge making, since they attempted to not rely on very specific industrial resource flows associated with the unsustainable contemporary conditions leading to the anthropocene. The low financial and environmental cost also contributed to the possibility of the works being in some sense more 'sustainable' because of this approach.

As shown by the projects and approach of the *ZDL*, which reuses hardware, the most *sustainable* computer is the one you discarded last year. Following this approach, a *sustainable* apparatus could make use of materials that are discarded, reused and recycled, representing low impact resource streams. The works completed included hydrophones which were made from stereo headphones and piezo transducers (a common electrical component used in alarms, microphones and cheap speakers).

Underwater video cameras used old, and apparently redundant DV cameras, waterproofed in pickle jars and sandwich boxes. A research vessel *(The Contingent*

Research Platform) was also produced which made use of materials from an office environment; suits, a desk and computer parts. Just how *sustainable*, or *resilient* these works are and what this means for them is discussed further below. First I will address the sensing equipment and the materials and apparatuses through which they emerged.

1, Hydrophones

The hydrophones made use of online instructions, both video tutorials and circuit diagrams and I developed two techniques for their construction. The first technique required the use of headphones which were bought cheaply (these bits of equipment can be found for a few pounds). The left and right speaker units of the headphones were carefully broken apart and separately sealed in small pots of vegetable oil (a medium which transmits sound waves that can be picked up underwater). An alternative method used a piezo transducer which was soldered onto a audio jack cable and plugged into a newly bought, but low-cost, mp3 recorder. This whole assemblage is then sealed in a mini sandwich box. This second waterproofing approach cost approximately 4 times more money, but included recording capability thanks to the mp3 recorder.

The resilience of the approach

Both these approaches depend upon the availability of low-cost consumer electronics (headphones, mp3 recorders). It becomes relevant to consider how resilient this design approach is and how dependent upon industrially produced components (as highlighted by the discussion of Thwaites' and Furtherfield's works in the previous chapter).

The resilience of this apparatus relates to the conditions that are relevant within a limited frame of time and within certain conditions. Such a dependency needs to be recognised. The design I used requires current widespread availability of headphones, either old and discarded or newly bought and they also depend upon cheaply manufactured mp3 recorders. Will that be the case in all futures? To ask this is to look at the resilience of the apparatus and the terms of its relationship with the resources and processes that allow it to come into being. In a more sustainable future, transitioned to by either a planned or catastrophic route, these products may continue to be available in high numbers even as redundant and discarded units. In

an unsustainable future (similar to the present) that manages to continue producing these components in similar numbers, the same conditions apply. The artwork is still viable. A first comparison suggests it should be resilient to some possible changes as described.

But, the continuing, increasing or declining availability of these materials cannot be predicted. The work is part of (what the theory of Panarchy referred to as) a disturbance panorama. Within this panorama of intensive connected changing conditions, industrial processes are dependent upon unknowables. They are contingent. But we do know that continued production of these goods does bring about changes of some kind within this panorama of society, economy and environment. The point and scale with which these changes might precipitate collapse or emergence of new conditions can only be considered in the most general terms. It might be possible to calculate the rate of adoption and market penetration of these different technologies (mp3 players, headphones, piezo transducers), but we do not know what conditions electronics markets will face in the future. Will such components continue to be plentiful and cheap, or will they become valueless or maybe even scarce and highly prized in particular locations?

By looking at the work and its dependencies in this way we see two issues pitted against each other. The social sustainability of widely distributed knowledge and components and the environmental degradation associated with their manufacture. The collapse and emergence of such competing scenarios is not resolved, or decided in any way by these devices. The work provides no answers, it just allows more options for future production by an approach that plays with cheapness, frugality, reuse and redundancy.

Fig 27. Hydrophones being produced in a workshop

2, Cameras

An underwater camera made use of materials and components from a different stage of redundancy. Producing an apparatus for the work *Kilnertography* I made use of a Mustek DV3000 video camera manufactured around the year 2000 at which point it retailed for above £100 and its 3 megapixel specification was a selling point.

Nowadays this camera can be found on second-hand websites for very low prices, and often fails to find a buyer at all. This could be called *redundant technology* (RTI 1996). It offers exactly the same functionality as it did when it was cutting edge. The equipment tends to work as well as it ever did. Nowadays it is regarded as well behind the *innovation adoption curve*, (Rogers, 1962) but the technology has not changed, only the curve.

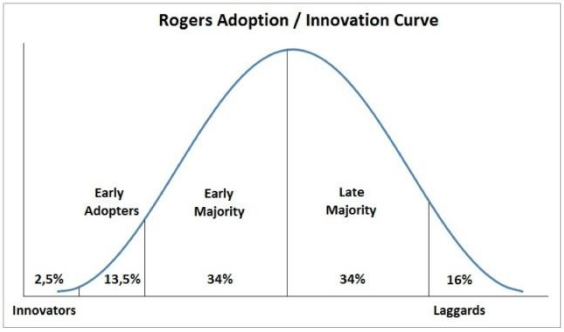

Fig 28. Roger's visualisation of change in social adoption of innovations, that might include technologies.

This curve, or wave, is a wave in wider societal contexts; in production norms, and expectations of specification and use. Changes in the conditions of production for consumer electronics goods are associated with intensive changes to unchanged (extensive) components. Technical options, factory capacity, supply lines and future construction options change, so do consumer preferences and expectations and retail price. As the wave of innovation progresses, the redundant object does not move 'forwards'. Components are transformed in numerous ways, sinking down into social neglect; perhaps more slowly if the product enjoys a 'long tail' of continued use (Anderson, 2008). This change in relations between society and material technologies is analogous to the movement of water particles – rising and sinking – animated by a waveform that appears to travel. And this technological wave is (as with water) intensive. The equipment doesn’t necessarily change. It is our psychological reception of it that changes as well as the wider social and material conditions required for its use – the other devices, software, manufacturing chains that it ‘plugs into’ or emerges from.

Fig 29. '*Kilnertography' swim camera (2012)*

The camera was waterproofed by enclosing it in a pickle jar. The pickle jar is a classic tool of self-sufficiency and preservation, familiar to American survivalists and suburban allotment holders alike. Together with improvised means of tying the jar to the swimmer's torso, this apparatus is capable of making films in shallow underwater depths. Such use, or misuse, may result in failure of the equipment because of bangs, or water damage. However, the current low cost of materials makes this an issue of minor importance. Just as *ZDL* observed with redundant computers, there is a steady stream of replacement redundant cameras. Certainly this is the case at the current point in this particular technology's decline. And careful use of the equipment can keep it working well. But as well as the 'intensive' wave of industrial production and consumption, these devices can also demonstrate their collapse through a more immediate extensive wave. Ultimately, bits do fall off. Batteries leak. Solder joints dry up and fail. Such apparatuses are emerging and collapsing in multiple ways concurrently.

Outlandish hacking as a form of resilience

Despite, or perhaps because of, the small scale collapse they brought about in materials, these works also prepared for, or in some way helped to alleviate, the pressures that could lead to other forms of collapse in wider systems. They were, on some level, preparations for failures that were not in existence yet and that may not come to pass. Large scale industrial manufacture and distribution may continue to be available for a long time. Approaches to marine photography other than cheap, diy re-use are currently possible and, in fact, much more common. These were

works that speak of some alternative or counter-factual set of circumstances or history. They played with alternative histories and realities.

But they also represent very practical ways of doing things within current circumstance. They did work. They are cheap and easy to make and I used them successfully, as have other people. Even more people, who might otherwise not be able or willing to commit resources to underwater photography, could also use these approaches as things stand right now.

Thirdly, through their resourceful and diverse approach to materials, they avoid or help to mitigate pressures on environment and economy that could contribute to larger systemic collapse. In terms of how I have been reading the complex connected change described by Panarchy and a thalassocentric perspective, they act to minimise the size of their own ripple that sits on wider waves of change, so reducing the impact on the 'disruption panorama' they are part of. This contributes to their resilience.

The works discuss, or present, a multifaceted form of resilience where the process of producing the work may continue in the face of changes that underlie it. They also consider how the process impacts upon the conditions of which it is part. They are (to some degree) future-proof as well as being low-impact.

The discussion, presentation and sharing of the process of collapse and emergence is a form of wave also. This takes place in what Guattari referred to as the socius. Again this links with the technosphere as we have seen above. But it is much more than a collection of components, facilities and distribution chains. If this way of working is shared (for instance online, or in workshops), then these works open up a space of cultural potential – a form of conceptual space where groups may exchange skills and capabilities that can reconfigure circumstances and play with eventualities.

The works enact a form of dialogue or entanglement with conditions in different directions. One direction being from the state of the technosphere (to use Guattari's word) to apparatus. In other words are we likely to be able to manufacture it at a later stage of the anthropocene? Another is from apparatus to the biosphere: does

making the apparatus change the world very much? And it also suggests the elusive connections between biosphere and technosphere: If we make many of these, will the biosphere change in such a way that our ability to continue making them will collapse? The stochastic behaviour of sandpiles is concealed in the entanglements of this apparatus.

Both hydrophone and camera were tested out in a workshop I led for the events *Hydrohack* and *Geohack*. These were conference events at Falmouth University, exploring art and technology (2013 and 2014). *Geohack* involved a number of workshops exploring how art and technology might 'digitise ecologies'. Among other activities, participants deployed a range of lo-fi research devices in kayaks and while sea swimming. These included the lo-fi waterproofed cameras used in a process named 'kilnertography'. This aspect of open sharing was an essential part of these apparatuses. They emerged from open communities of learning and so they had to be shared as results back with those communities.

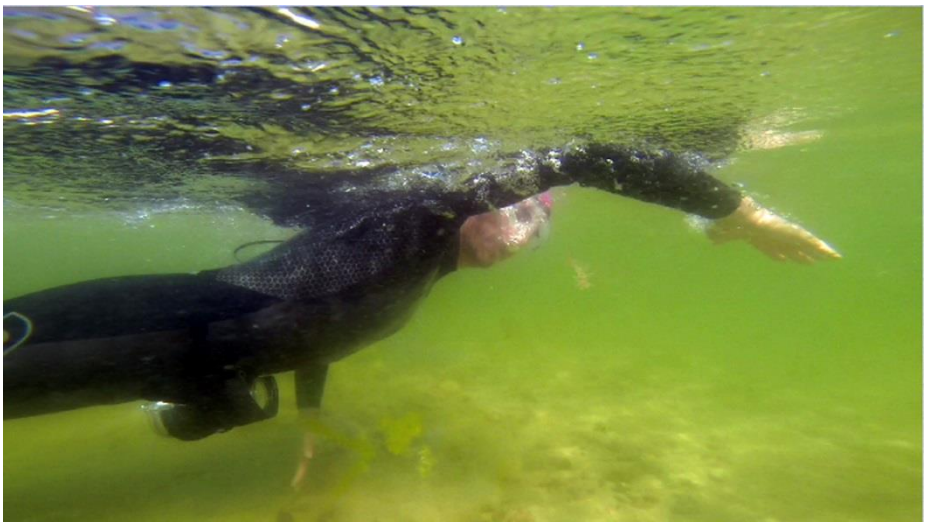

Fig 30. *Undertaking a Kilnertography swimming performance. Image: Nida Artists' Colony*

A film made as part of a performance lecture during a symposium at the Nida Artists Colony, Lithuania is viewable at https://vimeo.com/106575116 (as at 20th September 2015). This film, like others using this technology, does give a strong impression of sea swimming. The movement of the swimmer, the sound of the water, the strokes of arm and rotation of the body are all evident. As discussed in Chapter 1 and

explored through drawing, multiple waves and oscillations of extensive movement combine on top of each other. The substrate through which these waves are actuated is water, and light and sand (we see the ridging and build up of sand that accretes to make the peninsula of Nida a viable location for non-aquatic life). But again, the intensive waves of technological adaptation and its social dissemination are also present. The camera used was old for digital technology and very low cost. The film, once made, was shown instantly to a group of artists and researchers in a make-shift 'media centre' (involving an old laptop and towels to provide a shaded corner) in a pine forest behind the beach.

The second of these videos (https://vimeo.com/104799924) is shown being played-back on a laptop that is undergoing a process of collapse. This emphasized the elusive and ephemeral nature of information derived from this apparatus. Clearly the apparatus is fragile. But it is also visibly mediating any knowledge about the sea. The sea recedes from this apparatus even though it is entangled with it. Perhaps what we see most clearly is the ambiguous nature of the knowledge that is generated from this apparatus. Layers of dark and depths are discernible as above or below the surface of the sea. We can see kayakers, and shore, but the thing we know most clearly is the conditions of the tools that we are using.

A third swimming film (https://www.youtube.com/watch?v=T6tptZ1VC88) is less ambiguous. The camera successfully gives a good sense of being in the sea, below the waves, rolling and turning in sudden light. Bubbles pass and you can see swimming arms. But again the grey-greens of the deep, the intense whites of the sky and the diagonal cast of the movement and pixilation show the camera, its state of glitch and redundancy quite clearly. This rolling confusion and the process of production is the most significant outcome from these films. We have seen the apparatus and some of how it stretches into the marine. We have not unmasked realities of the sea that are probed in science.

These works lead on to another artwork of reconfiguration that demonstrated possible reconfigurations of subjective identity more clearly. This work showed how the knowledge that hacking processes depend upon could also better be understood as a wave of emergence and collapse.

3, Contingent Research Platform

To accompany, or support, the launch of these underwater devices I constructed a floating 'platform', or a marine research vessel, in fact a kayak. The '*Contingent Research Platform*' also considered collapse and reconfiguration associated with production and documentation of an artwork.

As well as building on open communities of boat building, the work could be understood as sitting alongside a body of other 'art' kayaks and boats. These include the already-discussed *Shedboatshed* (Starling), and other works such as *Kayak Libre* (Luksch and Patel) and *Ghost* (Chodzko, 2010), *Ghost Ship* (Dorothy Cross, 1999), as well as artist-built transport, such as Chris Burden's *B-Car* (1977); a demonstration of 'Robinson Crusoe technology' (Rombes, 2009: unpaginated)[xxviii].

Scientific research of the seabed involves the deployment of a range of equipment such as echo sounders, cameras, grabs and other test apparatus. The act of deploying the equipment can itself be seen as part of this apparatus, so the craft used to approach a site of fieldwork and launch the equipment becomes part of the apparatus of experimental knowledge making.

Research practice can involve high cost apparatus (ship hire may run to many thousands of pounds a day), utilizing very advanced equipment dependent upon an extended infrastructure of technological manufacturing. The financial implications also tie such large scale practices into dependencies of funding, with their associated demands of advocacy and political support (on many levels).

Furthermore, the ecological cost of deploying such large scale equipment can be significant. The manufacture of such equipment, its use and decommissioning can cause pollution, reduction of ecological capital (through mining for natural resources used within the equipment and use of land otherwise free of industry) and not least through the direct emissions during use of the equipment. International shipping is among the largest source of carbon emissions globally. 2.7% of global man-made CO2e emissions in 2007 were due to international shipping (2nd IMO GHG study, 2009).

A more resilient exploration of knowledge-making practices appropriate to ecological

crisis would have lighter impacts. Building on sections above and foregrounding the interconnectedness of natural, social and psychological changes, it is possible to consider such an approach. Again, it would have low economic and environmental cost, be responsive to available resources and have high potential for social inclusion and distribution within a community of others who might want to replicate or improve it.

However, an *art* apparatus attempting to operate in this space of marine research would not manage to reach into the same depths as industrial scientific apparatuses. Low-fi approaches will not produce data that will satisfy engineering project aims or produce data as startling as those of big science. But using constraints of ecosophy it could make this process of entanglement more visible. This would make visible the becoming, growth and collapse on different but connected plane/s of immanence.

Materials and Approach

So to produce the work I started with the aim of using the most *sustainable* materials and processes possible. Tracing the production; physical resources, processing and waste flows - with an eye on environmental impact - was a necessary part of this process. But so was an understanding of social implications of the project and those for the psyche – how the work *produced subjectivities* in Guattari's words. Again, this process began to highlight choices I made about my interpretation of what low impact or sustainable materials and processes might be. For instance, a kayak made with wood would release less volatile organic compounds than one made with a polyethylene or fiberglass hull. Steel smelting and working is a high energy business, so didn't seem appropriate. The distance the materials travel is also a consideration. So I reused existing wood that has reached the end of a previous useful life. This method became another process of 'hacking' involving finding existing material, breaking it down and remaking it in new form. But this intensive plane of immanence stretched further than was initially apparent.

Online community

Learning from the (largely online) community of diy boat builders, I chose a design approach that came from traditional Inuit culture – a method called skin on frame build, which uses local available resources; a good match for the project. These

self-build communities are also a necessary resource, distributing knowledge to make this project achievable. Again the apparatus involves social conditions of open sharing.

I did not want to use seal skin and whale bone, the traditional low impact, available materials for this build. Such materials are really exotic in post-industrial Britain. Finding and shipping them is the opposite of ecosophy. Returning to a hacking approach suggested more immediate and readily available materials such as suits, desks and computers. These materials are more available resources. They connect with the possibilities of collapse in social and psychological realms that are presented in the work of Dean, Ballard and Ader in the prevous chapter. But they are also in tune with approaches used by Furtherfield and Access Space when reusing redundant resources.

The artwork involved the sourcing of the most readily available solid wood office desk, business suits and a computer and breaking down these resources (bureaucratic jetsam), and reconfiguring them to make a marine research vessel that has used minimal new resources. Solid wood desks are not very common. I found one twenty miles away using eBay. A local ‘man with van’ drove it from Penzance to Falmouth and I cut it into strips.



Fig 31-33 Desk as materials for building a kayak – a type of apparatus for use in the sea

Even my minimal approach was dependent upon a van, petrol, a road network; the internet and a freely usable world-wide-web, with available (powered) PCs for a critically large network of users, exchanging stable currency.

Once I got the wood, I could have invested some more currency in a handsaw and tried to cut the desktop into 15 equal batons, but mistakes would mean I'd have to buy an extra desk. Instead I used the readily available 3-phase-powered table saw in the fully staffed, well-resourced workshop at the university where I was funded to undertake research. Here, becomings; waves of investment (many still increasing) were surfed or climbed with different choices of time, resources and availability.

Elsewhere some form of deterritorialization, or decline, was enacted. Value was extracted from forms of collapse. For instance the construction process required me to make and use a 'strongback'. This is the frame upon which the kayak parts are arranged and connected during construction. I managed to use the discarded desk drawers for this.

Fig 34-35. *Strips of desk are steamed and bent in the kitchen, then lashed together with wire stripped from a computer*

Fig 36-37. Spare desk parts are used for the 'strongback' on which the frame is assembled. This reuses the desk to make tools for the process of construction as well as for materials used in the finished object.

To bend the stringers (longitudinal members of the kayak), I constructed a ‘steambox’ from a domestic kettle and aluminium tubing. Wires from the computer (analogous to sinew or seal hide in an Inuit build) were used to lash the frame together. Instead of seal skin, cut from hunted seals, soaked and stripped of flesh and fat, I bought suits from charity shops. These may have been discarded by the newly unemployed or the retired; a social redundancy akin to the technical redundancy mentioned above. I cut these suits into ‘filets’ and sewed them into a patchwork. This patchwork was then wrapped around the frame and sewn tight. It was waterproofed with a mixture of linseed oil and beeswax. Alternatively gloss paint could have been used, according to some maker websites (backyardboatbuilding.org.uk), but oil and wax were materials that were easily available to me at the moment and were likely to continue to be so.

Figures 38-39. Suit as ‘skin’. Business suits are broken down, in a stage paralleling Inuit skinning of seals; the suit material is sewn together

Figure 40. The frame is covered with its skin

The cost of production was measured as fully as possible, including transportation of materials and the throughput of waste streams. These resources were documented alongside the work at the time of its initial exhibition:

1 Pine Desk
3 Suits
35m polyester thread
Discarded Computer parts
Epoxy resin 30ml
35 miles motor transportation
35 twin thread zinc coated woodscrews
25 minutes machine tool power
80 hours physical movement and problem solving

The waste was also presented alongside the work as:

Offcuts minus 1% loss (estimate)

This waste was later rerouted to other uses determined by other people and other projects (eg burnt for heat, used as planters etc), and which did not fall notionally within this project, yet can be considered within the entangled responsibility of the construction of the apparatus and the disposal of its waste. These material flows moved outside the project, to develop new waves of becoming as new uses emerged, then collapsed.

Figures 41-42 Waste is re-routed as a resource stream with other uses; here as planters and fuel used in a Cornish caravan site. Photographs: Carolyn Arnold

Finally, the cataloguing of costs of production included a reference to ‘Externalities’ which were described as not including 'conception'. This is a point that implicated the infrastructure of commissioning and gestation as a system that clearly has its own impacts and precarities.

Figure 43: *The skin is waterproofed with a mixture of wax and linseed oil*.

Figure 44: *finished kayak*

Commentary

While sharing some similarities with other art boats, this apparatus presents waves of connected change in original ways. Its visible entanglements include the office as an environment of written knowledge production; web based communities of hacker/makers and boat self-builders (a few of which share their skills and perspectives online); the leisure environment of pleasure boats on Cornish waters; the scientific laboratory; and the location under investigation (the Cornish sea). But beyond this it also makes visible processes of production, reuse and disposal which are implicated in the production and use of any form of equipment and it considers the cost of such processes in a range of terms.

I have shown how the attempt to restrict the damage associated with materials and processes led to further and wider considerations. Choice of wood led to decisions about transportation, then types of tool use. Power supply and maintenance of the tools used connects with, and depends upon, specific configurations of economy, politics and history. The further entanglements of the apparatus are looked into, the further they seem to extend.

A form of bureaucratic identity is also collapsed. Facing criticism in local press in Falmouth, *men in suits behind desks* are presented as the most distant type of knowledge producer[xxix]. They are presented as knowing little of the material realities of a location. This is an identity that was chosen as an available resource for reconfiguration. It is collapsed totally in this work, but then remade – is it dead or has it been reborn?

So the work also entangles the human psyche, reconfiguring a notional office-based knowledge producer, who becomes water-borne and moves from dependence upon high cost infrastructure to interdependence with the reconfigured debris of a broken-down office. This might be considered a form of 'psychological contingency', asking questions about the permanence and security of social roles and associated social opinion.

Is this identity in control of its change, or is it inundated by circumstances of rising tide and tripped up by the pratfalls of the anthropocene? This was commented on by a reviewer:

'I was intrigued by the way this piece scrambles the relationship between cause and effect. Does the desk make the canoe, or does the canoe shape the desk? Which is old, which is new? There's also a sense of revenge about it: PCBs and other components from the computer industry have entered Arctic waters and the entire food web, and may remain in the environment there for centuries. So let's dunk the computer – how do you like that? On the other hand, will pollution have so much of an impact that sealskin canoes will be an endangered species in years to come? It's a provocative piece – and tactile, too.'

Richard Black, former BBC environment correspondent, review of *Contingent Research Platform* at Not A Drop, 2013

The impact of this work is contingent upon a range of factors, at times stable or fluctuating within known ranges, at times in indeterminate ways. Its production makes planes of psyche, nature and socius visible. It emerges from these planes and addresses them.

The work was also implicated in material flows – ripples of deterritorialization and reterritorialization which are part of less concrete infrastructures – that existed in social and economic 'planes'. Examples include the internet trading site eBay, the university resources used to help shape the materials, the road transport network used to bring materials. Sometimes, but not always, it was possible to make these visible in the work. The hours of production were significant. The external nature of conception was also highlighted. Significantly it was made possible by a plane of socially distributed knowledge – the online community of boat builders (again built upon or feeding off other social and technical infrastructures). This group also had their own dependencies. Judging from the well-resourced toolshed and available free time visible in most YouTube self build videos, diy boatbuilding is undertaken by a particular comfortable demographic. The people who populated these sites also had a relatively high skill base. They appeared to have significant disposable income, for materials and for tools. These many levels of resource configuration sat underneath this hack, like waves beneath a ripple. They describe the many scales of the apparatus.

I aimed to use less expensive materials and equipment (where possible) and so make this approach possible for a wider demographic. However, these levels of cost and sustainability were always relative. And the work was made possible by the initial input of this relatively well-resourced online researcher group. It is possible to refer back to the model of Panachy that described high peaks in accumulated resources as less resilient and the ability to access otherwise discarded resources as a highly resilient strategy.

Using this understanding of resilience, the well-resourced leisurely maker experts help perpetuate this community of knowledge generation and sharing. But many others with less resources can still participate. They might have to use more improvisatory approaches or accept a less finished final outcome. The knowledge of the hack appears to be passing from sites (and people) with much accumulated resources to sites and people with less until it reaches those with no time or resources, who only look at the work. This describes the process of making these works accessible as a kind of wave, or spreading ripple moving from high peak to low peak.

The social ‘accessibility’ of this build is relevant. Clearly as a one-off work no-one else has access to this apparatus, but the instructions I post can be followed. And comparable apparatuses are common, if varied in nature. Recreational small boats abound around Cornwall’s coastline. These are accessible to those who have the money to buy and maintain the craft, and either store and transport them, or have them moored. While such costs are below those of ‘big science’, they are nevertheless prohibitive at some level and the community and established practices of self-build boating explores possibilities below this cost threshold.

In other words, there remains the question of just how far entangled apparatuses such as self-build boats extend. Do they extend to the paddler, their paddle, the launching location and equipment or support for launching (be that people, trailers or pontoons)? Such an apparatus may include the communities that helped develop the plans that were adapted and used. It may include the economic system that allows that community to engage in that boat building and the communications systems they use to share their knowledge. It may also stretch back to the Inuit hunters whose plans (adapted from where?) are changed by YouTube communities.

It becomes clear that total circumscription of the apparatus is impossible. This is not surprising though as, recalling our starting point, thalassocentric conditions connect beyond boundaries. The same finding was observed looking at Thwaites' *Toaster Project.* The waves that are visible in the sea sit upon slower deeper waves... ultimately in different substrates. To pick a point in this series of fractal, connected waves and call it centre or boundary is a convenience that only makes sense for certain types of knowledge. We might not be able to show the full extent of the apparatus's connections, but it can show some behaviours and movements in its connections. It can suggest some of the plane of immanence which it helps to configure.

Open sharing documentation

With the hacks described, the sharing of production instructions is recognised as part of the work. It is part of the apparatus. I sought to use ways of production that were shared easily, were accessible and readily implemented. The question of how to judge the ability for a work to be shared (with whom, when, for how long, at what cost...?) becomes challenging, but important if we are to consider its resilience. It requires us to consider existing conditions - digital connectivity, the availability of materials and free-time, but also looks to other conditions that might arise in other locations and other times, in other words in different disturbance panoramas and asks how costly is the information about how the work is made. This becomes a question about the *movement* of knowledge generated by the production of the kayak. This is another intensive, connected wave.

How does the knowledge and understanding of the work move and how does the understanding of the instructions of how to make it move, change, or remain meaningful in different conditions? This is the more meaningful way of thinking about the resilience of the artwork. And we are seeing that knowledge is generated and transmitted in material infrastructures, in social arrangements and in time.

Following open processes of production would mean that what I found could be learnt and improved upon by others – it would connect and be subject to change. Being open to and supportive of this was important if I was to make the most use of the resources I had put into the project (both in terms of its production, but also the research undertaken for the work, indeed the high level of investment represented

by an art specialism in an academic context). As much as possible of what I learned should be documented and shared.
The outcome of the work – the knowledge of the work being the work in many ways – can be seen to propagate as a waveform throughout a social plane of immanence constructed from groups of open exchange and sharing.

Again we face the question of how far the apparatus extends (this time socially, through the distribution of it as instruction). Does the documentation and sharing come under the same consideration as the production process itself? Is a resilient project dependent upon resilient documentation and knowledge sharing? This key question was addressed by a final documentation work I deal with towards the end of this chapter.

Such dizzying, fractal deterritorializaitions on multiple planes do not easily allow fixed definition. Again we see how the flexibility of this way of looking allows for different perceptions, from different lines of flight, but we also see the difficulty involved. The language of Deleuze is clearly elusive, but this is necessary in a world where change might be reterritorialization or deterritorialization based on where you view it from. As shown through Panarchy, the collapse of one ecology offers new opportunities for others. The ambiguity of these deterritorializations (in socius, environment and psyche) was commented upon when the work was exhibited in the exhibition *Not A Drop* as noted above.

So, just as open knowledge was drawn upon to construct the project, so the project would contribute to and change that pool of open knowledge. The obvious place to share the process of construction then would be in online communities similar to those where I researched the building process.
The site, www.instructables.com hosts a community of makers sharing build projects of varying sorts, and sharing comments on process from other users who attempt to make or adapt a build. I posted and shared the information about how I constructed the *Contingent Research Platform* on this website. I used the title 'Turn your office into a kayak'

I took photos from the construction process and wrote instructions for each stage. I then posted the 'instructable' (as posts about projects are known). The project

received a strong reaction, being selected for editorial feature on the website front page. In some ways (due to the type of audience) this form of presentation is more appropriate to this work than exhibiting it in a gallery context. This type of presentation emphasises process.

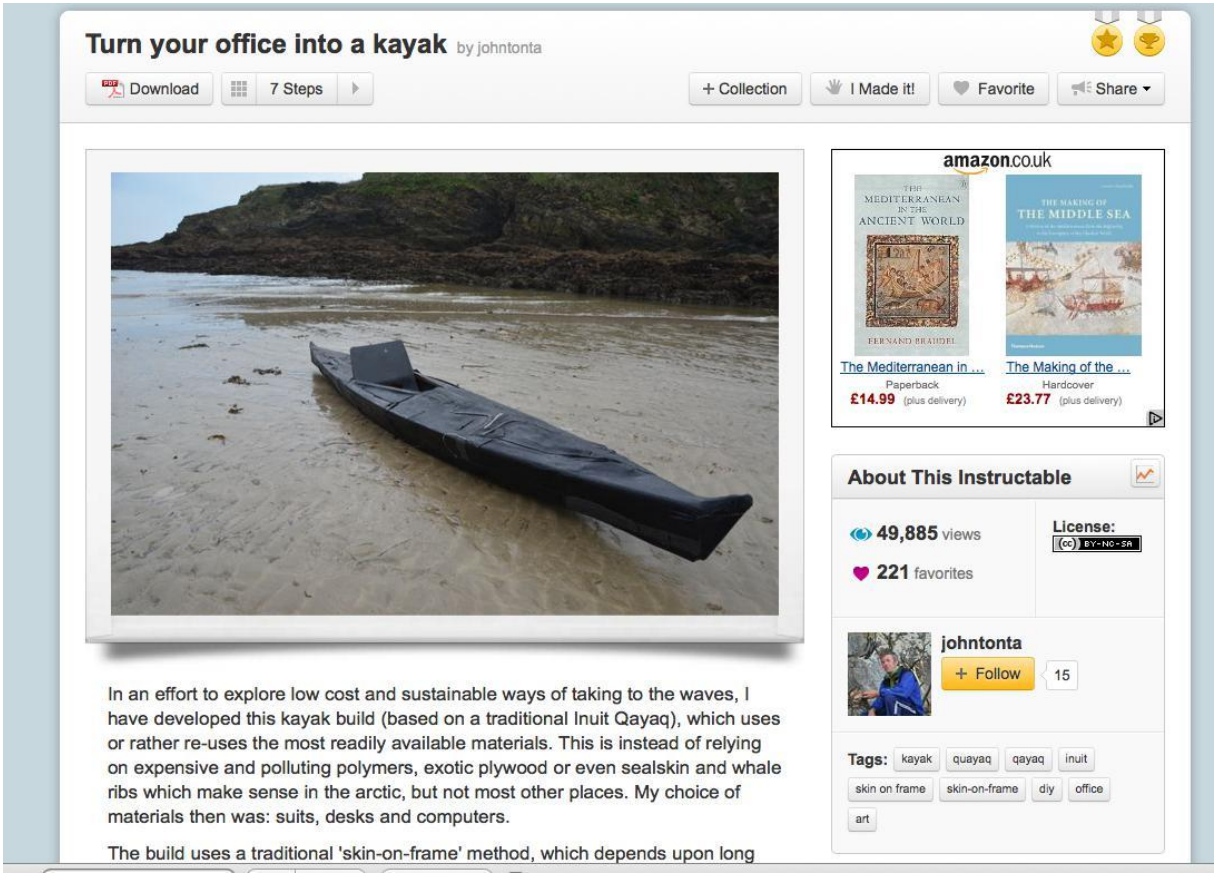

Fig 45. Online 'instructable' documenting and distributing the knowledge represented by this project

People clicking on and viewing the project are recorded by the 'stats' functionality of the website, available to registered users. This shows that 50,000 people viewed the project. The knowledge has clearly been disseminated in a wide network. But it is interesting to look at the timing of these views. A plot of views shows a great spike in visits to this project for a few days. Then visitors drop quickly to become a trickle. This spike and collapse in interest tells us as much about the type of infrastructure – or apparatus – that is being used to share the instructable as it does about the particular instructable itself.

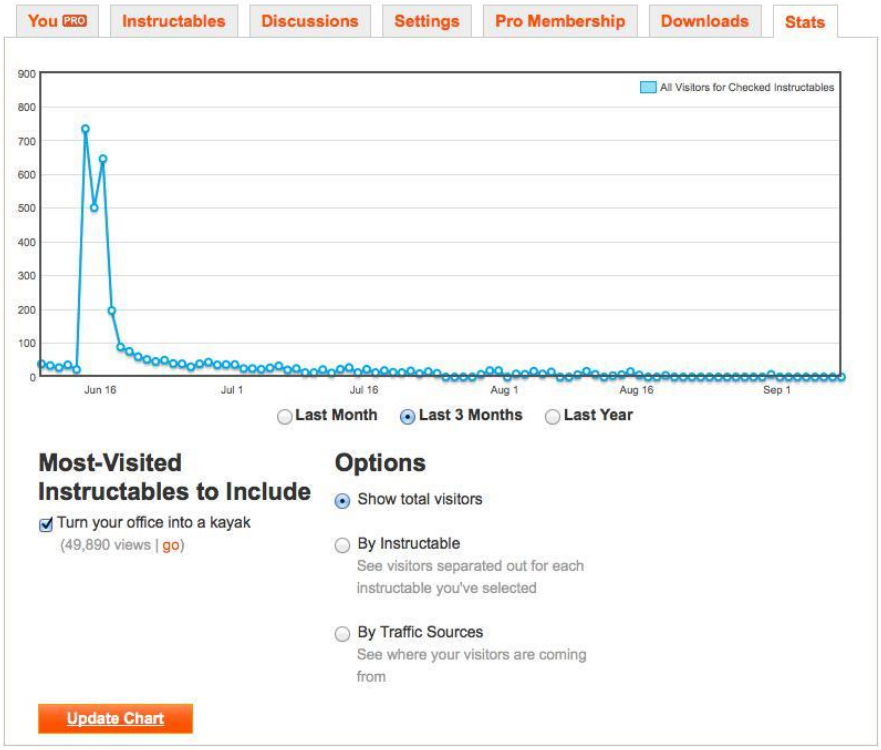

Fig 46. Web analytics showing the rise and collapse in interest in this project – an intense but short wave.

The website instructables.com has a large amount of content, which is being constantly updated. Many new projects are being documented every day. For the users of the site the experience must be one of constant renewal of information. Projects that are a few days old will quickly sink beneath the flood of new additions.

We see a wave of attention that is steep, high and quick to collapse. I make this point not to bemoan an inattention to work I have produced. Actually, receiving an audience of 50,000 is gratifying and very credible for many types of visual arts project. Does it matter if they all arrive at once, or are stretched out over a much longer time? Perhaps not.

However, when considering the project as an act that attempts to engage with resilience and reconfiguration, then how the knowledge that is produced endures becomes much more relevant. The artwork looks to reconfigurations at alternative points in time. It takes an existing material arrangement (in the most immediate terms, that of the 21st Century office), and reconfigures it to become a kayak. It also

looks to changes in environment that may impact upon other conditions. It suggests that at some point we might not find it as easy to get access to the craft we currently count on, or alternatively the office environment might change to become redundant for some reason. In many ways it is not a project that meets an immediate practical need. There are many research vessels successfully conducting research. Polycarbonate kayaks are available and relatively cheap. There are easier ways of being at sea than learning rudimentary boatbuilding, then breaking down and reconfiguring an office.

But this project is a project of the outlands. It deals with a deterritorialization of more than the materials of construction. Within the proposition where this project makes sense, the materials of possibility – the infrastructures that make up the extended apparatus – have been collapsed.

This is a proposition of outlandishness that looks to different times and different configurations in society, environment, psychology. There may be a time where it becomes useful and necessary to be able to construct sea-going vessels from redundant and recycled materials. That time is not now, but casting the imagination of the project into that time changes the practicality of these skills. The outlandishness of this project is temporal in part. And the temporal reach of the project becomes a very relevant consideration. In this sense a sudden collapse of the knowledge is not ideal. The work asks us to look outside our current time. When we do we cannot know what we will find, but we can make some speculations based upon our current knowledge.

I have shown that high volume websites have short attention spans. I have also shown that the archival function of the internet is not especially secure. For instance, we saw that the documentation of the project *Zero Dollar Laptop* was made unavailable because of a security breach of a media sharing service. This documentation – the open sharing – was an essential part of the social aspect of the art apparatus I argued *ZDL* depends upon and that I have discussed with regard to my own work. Other multiple vulnerabilities can easily be added to a list that makes the same point.

I have proposed a work that in some way attempts to extricate itself (through practical or imaginative means) from the current conditions of unsustainability. In some small way it alleviates some of those pressures, although it is still part of an apparatus of the internet, lorry deliveries, power tools and research institutes. More significantly, it also considers other conditions and other processes, besides immediate ones. Yet a large and significant part of that project is still implicated in an extended infrastructure that is very much part of those current conditions.

The artwork of making a research vessel from immediate acts of low impact hacking offers alternative ways of thinking about some of the problems of unsustainability. It establishes or proposes a form of outland. However, much of the project is still mired in the current conditions of unsustainability. This includes the use of several digital cameras and the internet. This is hard to avoid. Assumptions about distribution of the work remain invisible or unexamined. Deterritorialization, outlandishness and collapse are presented, but their visibility, the knowledge of them and the knowledge *from* them (ie the digital instructable, the documentation) is assumed not to be part of these becomings of deterritorialization.
How resilient can we assume the internet and the world-wide web that sits on it are?

The figure (above) of high peak and sudden collapse that was shown by the users of the internet is another waveform of emergence and collapse akin to those in ecologies, in societies, in the drawings considered above, and among other systems I have discussed in Deleuzian terms that emphasises their similarities. It shows the distribution of knowledge of an artwork as another kind of complex system. Such a wave shape might equally well be produced by the internet itself (experiencing some kind of collapse or reconfiguration) given sufficient time.
The internet is surely a Panarchy. Dependent upon so many conditions (ie highly connected, and so low in resilience in the terms of Gunderson and Holling), would the old age of the internet involve a gentle descent or a precipitous collapse? Will it break, become obsolete, or will many users get priced out of it? The multiple realms of ecosophical knowledge are clearly relevant to this problem.

Documenting knowledge-based artworks like the ones described ask questions of the sustainability of the documentation and the resilience of its trace.

Documenting Hydrohacks

In response to this demand for more visible and resilient extensions of the art apparatus in this social plane, I set out to develop a parallel instructable as a final stage to this research. This would not rely on server farms, worldwide telecoms networks, political and legal protections and continually updated and replaced desktop computers at high levels of global saturation. An alternative technology was offered by ceramic tiles. This was a technology that was developed in medieval Europe. Floors made at this time are still in use now, several hundred years later. The images that the tiles feature are still visible.

History of floor tiles

Earthenware floor tiles have been produced in this country since the early 13th Century at least (Eames, 1968: 10). The tiles, which were usually square, were produced by stamping wet clay with a pattern and in-filling the dip (a negative of the image on the stamp) with light-coloured clay. This method (referred to as 'encaustic') could produce a wide variation of final tile colour due to variations and impurities in glaze and imperfections in kiln air flow (Eames, 1980: 20-21). The result was a two-tone pattern in shades of dark brown (from red, to green depending on the glaze used) and a cream, to yellow, second colour.

The conditions in which these tiles were originally produced have now collapsed, to be succeeded by other emergent conditions. No medieval stamp has survived showing us the process, nor images of a stamp (Wight 1975: 64). But the objects themselves survive and reconstructions helped piece-together the process once more. Tiles manufactured with this method have survived in abbeys and other buildings dating from the fourteenth-century. Images they carry include ecclesiastic, heraldic or mythic designs. This is a type of cultural artistic apparatus that has emerged, partly collapsed (in terms of the knowledge required to produce it), then latterly re-emerged as a reconstructed method.

Process

I set out to produce a modern equivalent to this production method. Considering the resilience of the extended art apparatus was part of this process. This should be addressed in the manufacture of the work. It is worth remembering that these tiles function as the shared and open documentation of the kayak construction process,

rather than being a stand-alone work in their own right.

I was presented with a range of approaches to this task. I might follow the same approach I took when constructing the kayak, or that taken by Thwaites, and seek to find materials that were discarded and low cost. I might dig my own clay, finding different tones of clay body at different locations, no doubt involving travel and geographical research. Sourcing a block of wood might not be too difficult, and with a suitably acquired set of chisels (maybe offered for sale second hand, rather than bought anew and freshly manufactured) I could learn to carve the block in relief. Twenty blocks would have to be carved. I would then need to build a kiln. Kiln building is a relatively achievable skill; a fire pit in a garden is suitable for some types of firing and with enough fireproof brick a more complicated kiln can be made. However, the temperatures these kilns produce are very unpredictable and easy as they may appear to construct, using them well demands enormous skill and experience. I would have to address the economics of the fuel used to fire the kiln as well. On whose land was the timber grown for the firings? Very significant insights into uses and ownership of land could come to the fore when tracing and presenting the economies of fuel production, even when this fuel is timber, as modern agricultural methods, and business models that permit timber production are still likely to be part of the ‘carbon web’ (Platform, 2011).

But taking this approach would turn the manufacture of the tiles into a research act that sought to open up the connections, the changes and the scales of emergence and collapse of contemporary unsustainable living. This finding would duplicate the findings from the construction of the kayak. Documenting this kayak in this method would present the process of kayak construction, but not present the process of tile manufacture, which would be displaced to another cycle of documentation. But that would require yet another process, which could then also be presented. Investing large amounts of energy, learning and time in experimenting to then make new devices (using archaic methods), would not be particularly low impact. Even if the materials were non-industrial and non-polluting, this would still use a lot of resources. Not least of which would be the time of the researcher. Furthermore I have already shown, through a discussion of Thwaites project, that apparently self-sufficient processes are dependent upon many connected pre-existing conditions.

Considering the dependencies that are part of the work, the energy invested in documentation becomes an echo of the original project. Do the dependencies of this echo need to be considered too? To follow this to its conclusion might require ever-greater energy to trace fractal ripples of documentation of documentation. But this energy is not necessarily best placed.

An alternative way of manufacturing encaustic 'medieval' tiles in 2014 would be to use the most available technology. Rather than building a kiln, with many hours of labour (and untold economic costs associated with that work time), use of an existing one would involve less impact. Remembering findings from Thwaites, it is not possible to start from the ‘ground up’.

Accordingly, I proceeded to use the full range of equipment that was readily available for university research. The result is a tile that while medieval in its lineage, is most clearly contemporary in manufacture. The durable nature of the substrate, and the intended use as resilient documentation bring an additional temporality to this work. Its audience could exist in the far future. That it could last beyond the work it describes is clear, but it is also possible that it might last beyond the tools and infrastructure – the apparatus – that produced it. Tiles from 13th century are still readable today. Could we assume that electric power kilns, computers and laser cutters will be present (or possible) 800 years form now?

Fig 47. Digital manufacturing facilities (a laser-cutter) in a well-funded university research department offered a way of producing tiles with images that had a relatively low impact

In some ways this mixture of archaic and contemporary approaches, mirrors the approach of the kayak's construction. It was a craft that followed a pattern derived from traditional Inuit design, built using discarded office materials and in form it was equally familiar as a Cornish leisure craft.

The initial kayak production was a low tech process, with hidden dependencies of high-tech documentation and distribution. With this mixture of archaic substrate and contemporary production process the tile production becomes an example of what Leah Buechley has called high-low tech (http://highlowtech.org/). The tiles acknowledge their position at a relative high point in a resource and technology accumulation. They make use of the most available existing processes and materials.

Starting with the photographs used for web documentation, I developed a series of images that could function as instructions without text. While retaining numbers for guides to the proportion of the build, I chose to remove text (an integral part of web instructables). This is because the encaustic tile medium rarely carried text to any significant degree. The process of imprinting and filling the clay is not suited for large amounts of fine details, such as extensive blocks of text. Omission of text and image-only communication also transcends any barriers of language. When constructing a form of communication that will be resilient to unexpected contingencies, greater simplification appeared a sensible principle. The results could last longer in the face of uncertain social changes.

Comparing medieval tile designs, we see that the detail and complication of images is as good as any I can produce. However, the images I have in tile form were much quicker to process once the basic technique was learnt. Medieval tile production required a wooden mould to be carved. I only needed to laser cut my mould which took 20 minutes a tile.

The medium only allows large blocks of single tone. I was intending to use a single light coloured clay slip on top of a dark terracotta clay body, rendering a total of two tones with no graduation or greyscales between these tones. The images had to be adjusted to show only black and white as a result. This would be rendered as dark red/brown and light cream in the final tile. To adjust the photographic images that I

had taken previously I used Photoshop CS6, running on a 2.26 GHz Intel Core 2 Duo Macintosh personal computer made available through Falmouth University. Having used this software product many times before, I found it quick and easy to discard colour information and increase contrast in the images, then process a ‘threshold’ to arrive at a two-tone image which could then be adjusted with pen and eraser tools to my satisfaction. Some stages of the kayak build required images that were not available as photographs, so I scanned a hand drawn image on Falmouth University's multifunctioning photocopy devices and processed the image from that.

Next I transferred a digital image into a relief image cut in a block of particle board, to be used as a stamp. The images were imported into the design software Corel Draw. From there they could be sent to proprietary software managing a Trotek laser cutter. The laser cutter works like a printer on a page with laser replacing inkjet. So instead of leaving ink when the moving head encountered a part of the image field that was black, it burnt the particle board, leaving a pit or trough at that part.

After having cut the twenty stamps, I put them in a custom-made frame and threw clay into the frame, pushing into the corners carefully. After trimming away excess, the mould and stamp were removed to leave a tile with indents in its surface. These were filled with white, liquid clay (slip) and left to dry. The image was cut back to remove ridges and bumps and reveal the two tone image, which could then be fired.

I list the machinery and skills used in this stage because clearly this was part of the extended art apparatus in use. The process made use of existing skills and tools at many points. It is also clear that the political and economic apparatus surrounding university research was used here. My access to these machines, their power and maintenance was part of the extended apparatus. So too was the instruction I received about these complex processes, materials and machines. This infrastructure is again inextricably tied up in what Marriott terms the Carbon Web and its attendant project of economic growth. My approach to these tiles was to bring this wider apparatus into greater visibility.

The finished tiles are a parallel documentation of the work, duplicating the internet-based instructable. They too act as an instructable, although with no text

instructions. The number of views they receive will never rival the peak of the internet version, but they have the potential to far outlast the internet. Ceramic tiles of this style are still in place in the floors of monasteries and cathedrals from the middle ages. Indented clay blocks carry the first traces of writing known to archaeology as well as early boat building information.[xxx]

Fig 48. Clay tablet written in about 1750BC telling the Babylonian *Story of the Flood*. The tablet describes the materials and the measurements to build it and quantities of palm-fibre rope, wooden ribs and bathfuls of hot bitumen needed to waterproof the finished vessel.

The final tile in the series lists the materials and resources – aspects of the extended art apparatus that were used as part of the apparatus's own construction: Cameras; scanner; computers; software; clay; laser cutter; particle board; kiln; electric power; expert instruction

Fig 49. Fired tiles

These tiles are not necessarily more robust than other digital forms of documentation. They clearly do not have zero emission, nor are they self-sufficient in any way. And yet the approach to their production is thalassocentric.

Summary of Original Artworks

Complex changing connections

The original works developed here trace connections (between environment and society, technologies and infrastructures) across multiple orders, scales and realms in material processes that are systematic, intensive, complex. They trace the wide ranging entanglements of the apparatus. They show that the apparatuses that approach the sea connect and change in ways that are similar to the movements of the sea and in ways that show the connections and changes in other planes.

These artworks produced knowledge about the environment without having to mend situations, or produce predictable mechanistic outcomes. They did this by acknowledging and using material entanglements of psyche, environment and socius, using forms of play and recongifuration.

Emergence and collapse

I have shown how collapse and emergence appear different according to contingent perspectives (whether those of human, native non-human species, or invasive species). They allow and even demand a shifted perception from the normal human centre towards wider conditions and process.

All of these transformations perform emergence and collapse across time in ways that are not reversible or symmetrical, and in ways that also inform our expectations of collapse and emergence in terms of history and future. These forms of change can be seen as an intensive wave of becoming (as shown in drawings or in sand or in electronic equipment).

Materiality and technology

In previous chapters I showed how materiality was not passive and mechanistic, responding to inputs with deterministic outputs. It has its own agency. A review of art by other artists showed how non-human life and the marine environment can create 'artworks'. The works I produced and discussed in this chapter show the behaviour of materiality that in some ways includes ecologies. They address the use of resources. And trying to reduce the impact of making a work of art shows how processes of art, research, transportation and knowledge dissemination are connected to each other and are all part of the ways society currently operates,

which is acknowledged to be unsustainable.

Attempts to reduce the environmental impact of the artwork to zero are not possible, but the failure of this total reduction does traces the lines of impact and the lines of dependency that constitute an art apparatus. The works show that collapse is an unpredictable behaviour of a complex system and art apparatuses are complex systems.

Technologically-framed forms of art production (including hacking) make this point especially clearly. The collapse and reconfigurations they perform include reconfigurations of social and environmental arrangements. Hacking need not be exclusively technological, but can be undertaken in societal planes. For socially-framed hacking works, the knowledge of how to hack is part of the artwork. Technologies are implicated in mind, socius and environment in many ways, akin to the connections of the sea. They stretch across ecology and they can be thought of as including the processes of work production and knowledge production. Technologies or materials of artistic production are entangled and continually changed, performing their own waves of emergence and collapse on a plane of immanence. They form an apparatus within society, psyche and environment.

Arts practice

Alternatives to unsustainability suggested by different forms of arts practice seek to change aspects of their dependencies. This includes industrial infrastructure, sets of skills and communities of creative production. Yet this approach can exchange one set of dependencies for another. I showed this in the limits of self-sufficiency explored previously by Thwaites and *ZDL* and here in the manufacture of these artworks of mine. Even though it is possible to remove, or limit dependency upon expensive, environmentally damaging hardware and software, dependency shifts to other networks of learning, transportation and power that are part of wider research and art cultures. The works in this chapter also draw attention to how documentation is also part of this dependency and so part of the apparatus. Rather than becoming self sufficient (as expected by certain types of environmental narratives), these works just rearrange their dependencies and hence the sites of their potential collapse. That rearrangement might be lower impact and more resilient, but it is not avoided.

The form of art apparatus – a thalassocentric art apparatus – is in some ways more sustainable and resilient though. But it manages this by acknowledging that such aims are contingent and nested in temporary social and material conditions. It underlines the connections to systems around the artwork. The extent of these connections appears impossible to bound and decide with finality. These works present material and ecological transformations – in matter, in conditions, in perceptions. These transformations are performed within and around us as one part of a wider system.

The works show that knowledge about change precipitates change, but the behaviour of change itself is hard to know – this can be considered through a thalassocentric perspective, including a familiarity with the becomings of waves (treated in earlier sections of the research), their speeds of emergence and decline. Artworks show this multi-scale connectedness; the condition of being implicated in connected changes in clear and powerful ways. The artworks both read and write their own waves of emergence and collapse.

Chapter 9 Research Summary

Research Process

This thesis addressed a number of questions that were developed over the course of the research. It aimed to demonstrate how forms of change, familiar through the movements of the sea, can be perceived through arts practice in a way that is relevant to ecology in some expanded sense. It had to overcome problems of atomised perceptions in disciplines and in ecology to clarify exactly how this expansion could work for arts-based understanding. To do this it was necessary to develop a perception that moved beyond the dualism described by Latour as 'bicameralism'.

I have used non-arts disciplines to evaluate arts practices in the context of a type of marine-aware ecology. At times the works were totally immersed in the conditions of the sea, at other times they were directed towards other conditions, but still retained an awareness of how the sea moves, connects and changes. These arts practices in turn have been able to make a range of perspectives or bodies of knowledge relate in ways that are (after Guattari), ecosophical, or thalassocentric. These complementary forms of understanding; of practice by theory and theory by practice do not leave either form of knowledge unchanged. There is no 'fixed referent' in the words of Barad. They diffract one against the other. For this reason it has been impossible to assemble this research as a series of complete sections that can then rely on unchanging foundations. Drawing each perspective into play has altered the whole, so that the elements can only be considered once they are all included. I have shown how this methodology is appropriate for arts practice and appropriate for ecological contexts. It is drawn from an understanding of the movements of the sea and recognised in continuations of those movements in intensive phenomena.

The written report

In chapter 8 I applied the criteria used to judge artworks to the documentation explaining those artworks. If an artwork should show connected change over many scales, I asked whether the artwork's documentation should also do this. And this is a question that could be extended further still; to the written portion of this thesis reporting on the process of research. In this thesis, the clear, linear narrative appears to comment on the research process in an (apparently) objective way; observing the process from a stable critical dimension, removed from twists of practice (similar perhaps to the critical dimension rejected during discussion of the Deleuzean plane of consistency, above). Throughout this research, I have used complimentary forms of understanding that do not leave each other unchanged. I have shown processes of connected change (emergence and collapse) in knowledge and in the structures that produce and communicate it. So if disciplinary knowledge changes alongside the arts practice it addresses, might not the process of writing also be expected to demonstrate thalassocentric shapes of change? A style could be adopted where the forms of language flow, or break down, and are demonstrably changed in some way by what they address.

I have not done this. Such writing would initiate a new, literary impulse, leading the process of research towards new explorations. And when discussing the impact of documentation I have shown how widening the processes under consideration adds unexpected implications and complications. The practice that drives this research has been a visual arts practice that engages with changes visible from the sea. The writing and the choice of critical resources and the research tools that develop through the thesis have followed from the acts of that practice; showing shapes of change at different scales around it. Rather than starting and following a new set of creative ripples, the shapes of change inherent in the written form might instead be better demonstrated by looking for it outside of literary style. Addressing the dependencies of the written report, and the social and economic arrangements of doctoral research might do that, and offer valuable challenges to the linear expectations of the research degree process. At the right scale, processes of writing may well be made to show varied intensive crests, troughs and interference caused by the research at hand. But that is another phase of research and beyond the scope of this thesis.

The methods I have assembled here acknowledged, but did not replicate Actor-

Network Theory. They concerned connections and relations between the two cameras described by Latour. They did this by addressing apparatuses, but they looked at their behaviour in terms that were Deleuzian and ultimately artistic.

How artworks functioned

I presented a number of artworks that in initial stages were able to explore and refine the investigation, throwing up problems informing subsequent work. These works moved in stages towards a point where I was able to build criteria that would suffice to evaluate existing works of other artists and also support the successfully completion of final works of my own that satisfactorily addressed the aims of the research.

The works undertaken as research developed and progressed to show a common form of oscillation observable in sea, in technology and in sociocultural conditions. I showed this by drawing attention to how (what I termed) 'art apparatuses' change and connect otherwise apparently incommensurate realms.

Interdisciplinary perspectives

I asked whether and how the knowledge produced outside of arts practice can be reflected by art, and how it changes and is changed as a result. Karen Barad's post-humanist method of diffractive reading provided a way of asking this question. Exactly what was assembled, then diffracted (artworks, theories, disciplinary knowledge, etc), became a methodological process that supported the progress of the research and clarified my form of expanded ecology.

Looking at critical, ecological and philosophical theory helped clarify how arts practice could sit alongside other disciplines (such as science, geography and history) that offer different forms of knowledge about the sea. It also helped shape the requirements against which practice was judged.

The role of apparatuses

I evidenced how engineering practices that put human control at the heart of the anthropocene use apparatuses that tend to become invisible within the realms in which they are deployed. The apparatuses draw attention to activity at one location along them, where they supposedly focus, but ignore entanglements along their

length.

I described how scientific apparatuses are presented as producers of objective facts without subjects, even though science has a social foundation of subjects. Hence, they perpetuate an object/subject separation inappropriate to thalassocentric conditions in the anthropocene. Foucault's apparatus, in comparison, is social but it overlooks the non-human. Meanwhile, post-human apparatuses can entangle human and non-human in ways that can co-produce objective fact and discourse. Their limits may be hard, or even impossible to determine. Arts practice is an apparatus too that can be said to include galleries, institutions, materials, processes and subjectivities.
I consider the thalassocentric apparatus to operate as one form of post-human apparatus that cannot easily be understood as separating or atomising people from the non-human world they attempt to address and I sought to show how its movements demonstrated something of the connected, multi-scale changes of the sea.

Collapses and reconfigurations showed some of the ways the apparatus moves. These changes were seen as types of movement in and along the apparatus. It appears that a definitive outside edge of the apparatus cannot be found. In many ways it appears fractal.

Initial sea drawings managed to register immersed, subjective and intensive changes in the sea. They showed the non-human movement of water, but also by association other human and non-human processes too. They appeared to show emergent forces, but they overlooked their own processes of production and the impact and reach of those processes. The apparatus of which they were part included skills and resources that were ignored, even though the process of drawing was inescapably entangled and change-inducing with the world.

Attempting to address the problem of binary separation in the work and in its process represented a main challenge for the research.

Works using sandpiles and electronic sound equipment showed material emergence and collapse within the artwork itself. This was a more integrated and connected

way of showing behaviours of change, their unpredictability and potential. The mechanics of emergence and collapse were linked to complex non-human and human systems. This suggested ways of understanding the behaviours and changes of resilient systems. The process of artmaking, was included in some ways within the work, in particular by looking at the origin and impact of the materials and equipment used. This proved to be a key approach developed later. The performance artwork presenting sound and changes in technological equipment was able to show wave shapes in different parts of the apparatus, but it did not connect these well, so progressed the research to consider conceptual space.

Conceptual space

I considered different types of theory describing these complex changes in types of conceptual space. The investigation of sea, and comparisons between ecology and philosophy showed that the conditions under consideration do not remain static. The dynamic nature of complexity is described by Deleuze and Guattari's double pincer; a never-settled point of balance between emergence and collapse that is also recognisable in the theory or metaphor of Panarchy. Despite their different origin, these theoretical perspectives showed changes occurring across fractal orders, or in nested levels within structures that encompass people, knowledge, societies and non-human environments of many sorts. Learning from ideas of Panarchy, we see that as underlying conditions change so systems that sit on top of those conditions are required to adjust if they are not to collapse and potentially spread that unpredictable collapse elsewhere. Sea-like conditions were found in intensive arrangements that were creative and that applied to natural systems and to systems such as cultural production, including the process of making and distributing art. These conditions were described as existing within folds, or other oscillating wave-like structures that avoid binaries.

I had to ask what was the space or scale that could show this connected change and how many dimensions does it have. Panarchy addresses conditions of collapse and emergence, but it does not *use* them. Panarchy clarifies how ecological Deleuzian thought and tools are, and how these movements can be conceived as shapes that art can describe in different ways. But Deleuze and Guattari's insights are necessary to recognise the position of practice within ecological thought – as thoroughly implicated in what it addresses. That is to say that the conceptual space

described does not exist in an additional dimension of transcendental reflection. You cannot look down on it from outside. I found that a thalassocentric perspective is not (as Gutting described Kant's transcendental aesthetic) a 'special epistemic realm' separate from what it looks at.

These diffractions, comparisons and reviews returned the research to the original question and refined it. I was finally able to ask how arts practice can show movements of intensity that connect scale and change in the non-human and human. Instead of asking how much of the connected changes of the sea can be perceived, it ultimately became more meaningful to ask how many of the myriad layers or scales of that change are relevant and what is the manner of their change and connection. This became a sea-like perception.

Practice Review

The works showed complex changes of the anthropocene involving psyche, technology and society. How these changes connect and progress varied in the artworks. Galleazi showed how her art apparatus was implicated in the issues it critiqued. Starling's work reconfigured subjective positions and the history and identity of materials. Dean's works connected multiple collapses in materials, personal stories and traditions, often using the sea as a figure to help frame and reflect these types of movement.

Hacks in different materials and conditions performed reconfigurations that were social, material and environmental. They required social distribution of information about their own production if they were to work on their own terms. Their absurdity, or counter-factual nature can be a powerful way of understanding potential change, or dependency that is not easily perceived otherwise (as with Thwaites and Bunting).

Hydrohacks Showing Waves of the Anthropocene

These works used socially distributed knowledge, locally available resources and existing types of identity in which they 'performed' types of emergence and collapse as 'hacks'. These apparatuses traced their own waves of becoming in multiple intensive ways. They showed behaviours of material systems that are dynamic, not static, culminating in the movement and change in the apparatus, and its potential

for showing connected intensive movements and changes around it at different scale. In these ways they 'read' the movement of the sea they address through the apparatus, its use of contemporary and archaic entanglements and connections of possibility and outlandishness.

An original contribution to knowledge that resulted from this process of research was how art behaviours help to read processes of change in the anthropocene, as they highlight the implications and connections of their own production. As decisions and events occur during their production and dissemination, the art changes its connections with resources. It shows fragilities and movements in infrastructures of human and non-human system that include but do not centre on human subjectivity and society. These works showed how they increased their resilience and also their fragilities by highlighting the resilience and fragilities of systems (ecological systems, social and material systems) from which they emerged. Whether the artworks produced are truly resilient or not cannot be answered by this research and the research challenges whether this question can be asked meaningfully outside of contingent bounds. The movements and changes of the works had a wave-like characteristic common to the sea. Even though they were not necessarily directed towards the sea.

Using the perspective developed within this research we can see changes in structures and resources as types of collapse and emergence; wave-like figures. Conditions and arrangements in environment, society, individual lives and economy are configured in ways that result in practices or apparatuses that produce knowledge. This includes conditions in and around the sea.

Thalassocentric apparatus

The research presents forms of emergence and collapse that include us, but that also includes the apparatus of knowledge making.

Artistic practice is shown to be rooted in processes of emergence and collapse, in psyche, non-human conditions and in society. These connected changes constitute an art apparatus. When these entangled processes of emergence and collapse are brought towards visibility (even though this may be impossible in entirety), then the apparatus can be thought of as thalassocentric. In this case the thalassocentric

apparatus demonstrates intensive movements which can also be recognised from the extensive movement of the sea. When considered as a form of changing and connected knowledge, I have shown how the thalassocentric apparatus can lead to a form of resilient art making.

i I am grateful to Jan de Graaf, for introducing this phrase during the lecture 'Difficult Landscapes, Difficult ways: reinventing the riddle of the sands' (2014). He initially attributed the phrase to Braudel, although in subsequent correspondence, he suggested a number of other possible sources: "Perhaps the term 'thalassacentric' is *not* used by Braudel, not in his book Mediterranean … perhaps the term thalassacentric occurs in Braudel's posthumously published Memory and the Mediterranean (1998), in the introduction by Murray. Or? Or, was it used by Claudio Magris when Magris introduced himself as a potamologist (river expert), giving a name to Braudel's and later Matvejevic's work on the Mediterranean Sea?' (private correspondence, 2014). The term is not found in the references mentioned. It is possible that the phrase is de Graaf's own synthesis of extensive research.

ii In a review of descriptions of complex systems Ladyman, Lambert and Wiesner (2013) observe that 'there is no concise definition of a complex system, let alone a definition on which all scientists agree' (Ladyman et al, 2013: 34). They are nonetheless able to describe a set of core features common to descriptions of complex systems. These include: nonlinear behaviour with feedback, displays of spontaneous order, robustness with lack of central control, emergent behaviours, and organised structures with many levels and numerous parts.

iii We have moved 'up' another order of complexity as this is now looking at changes in changes.

iv This term is clearly inadequate for a marine location, but exactly what might be used instead is not obvious at first. In subsequent chapters, I use the work of Deleuze and Guattari to explore intensive spaces that can include the sea. Their terminology of plane or planes offers a useful way of thinking about alternatives to terrestrial space.

v A cultural and artistic application of ecological science can also support what Manzoni and Till (2015) call the 'cultural side of resilience'. Resilience as a term is often applied in technical and 'defensive' ways to describe socio-technical systems' capacity to absorb stresses and failures without greater collapsing (ibid: 11). This can lead to resilience thinking being a tool for problem solving. But it can also be applied in a cultural way that recognises diversity and creativity. In that case 'A cultural approach to these questions would not attempt to solve 'problems' per se, but open up new possibilities in order to feed and support a social conversation' (ibid: 13). By moving from technical and objective discourse to a narrative that retains material behaviours but uses subjective and cultural perspectives, the relevance of terms like 'resilience' is changed. It can also be compared to the idea of sustainability, defined within the UN report Common Future as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland Commission, 1987), although the comparative fixity of a notion like sustainability is not as flexible to uncertainty as the idea of resilience, which will be considered in more depth.

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vi Gilles Deleuze comments on the use of the term *outlandish* by Melville in an interview with Claire Parnet. "'Outlandish' is always coming up...'Outlandish' is exactly the deterritorialized. Word for word." (Deleuze, Parnet, Boutang, 2011: 13:51-14:12). See also London Fieldworks' naming of a remote ecological retreat *Outlandia*.

vii Types of knowledge about the unforeseen have been produced and combined in many ways. In a history of the sea, understood through play, Rozwadowski notes how

'The sea has been used and understood as an arena for war, of diplomacy, a font for resources, a blank slate for discovery, a platform for movement, and a focus for reflection' (in Vetter, ed. 2010: 184). And yet these competing conceptions have combined fluidly and even playfully. 'At all times since the eighteenth-century discovery of the seashore, the relationship between people and the ocean has involved play as much as work' (ibid: 184). The 'category of play seemed intrinsic to the connections between people and the oceans that emerged at that time' (ibid: 184).

viii This separation is also referred to as a 'Cartesian Cut', after Rene Descartes, who described mental substance or res cogitans as different and separate from res extensa or the material world (Descartes, 1988).

ix There are many examples of artworks that use artistic and creative methods to make knowledge produced by science intelligible to a general audience in different ways. Other examples include *Ice Core (2005)* where Shiro Takatani of Dumb Type presents and interprets measurements produced within scientific procedures.

Elsewhere, Marcos Lutyens and Alessandro Marianantoni, cross between the crafts of scientific measurement and the experience of artistic installation to present data with the work *CO2morrow* (2009, Carbon fibre, LED, aluminium and data stream).

x Barad's description of the entanglements between a traveler and their computer on a plane, an industrial facility in China and corporate stock value shares some similarities with the range of sociological methods referred to as Actor Network Theory (ANT). In many ways she could be describing an Actor Network. Does this mean that my description of the connections of the sea follow ANT?

I will be using her method to understand the disciplinary arrangements that support this research, and my own approach to the connections of the sea also share similarities with ANT. The research undertaken here does owe some of its origins to ANT, as described through the work of Latour. But there is no single theory of ANT, which has developed and changed. Its success, initially as a sociological process, 'led to its dissolution' (Law, 2003: 11) and it has become 'a patchwork of similarities and differences that performs not one but many worlds' (ibid: 10). This research is not undertaken as sociological research, nor does it seek to provide understanding that does the job of science. It is artistic and cultural and addresses changes that are ecological. This mix and variance will be touched on in the summary of the research. So while these entanglements can be recognised in other theories and the theories that support ANT may also be of help in this research, it isn't necessarily helpful to think of the research as following ANT.

xi Marine engineering company, Mojo Maritime supported this research project as a commercial partner, offering dialogue and an exchange of information about their involvement with renewable offshore energy generation.

xii The wetsuit I used for these drawings was manufactured in China, from neoprene made in Japan by the Yamamoto Corporation, at either its Osaka or Okayama plant. Description of this complex piece of equipment is found on an manufacturer's website. It gives an idea of how this piece of swimming apparatus is entangled with many industrial processes:

'A wetsuit is made of foamed rubber, sometimes called a sponge. It can be laminated on one or both sides with fabric – usually polyester or nylon in a jersey knit. The pieces are glued and/or stitched together to make a wetsuit, and then the seams can

be sealed to prevent water leakage. The sponge is made from polychloroprene rubber chips, commonly called neoprene. These are melted and mixed together with foaming (blowing) agents and pigment, usually carbon black, and baked in an oven to make it expand. To make the polychloroprene chips, the manufacturer polymerizes chloroprene monomers, which means reacting small molecules together to produce the large macromolecules (polymers) that make up rubber. There are two methods of manufacturing chloroprene monomer. The most common method ... takes butadiene through a two-step process of chlorination and subsequent dehydrochlorination. The butadiene for Method 1 is derived from petroleum...Like gasoline and most synthetic chemicals, the origins of butadiene for making chloroprene via Method 1 start with oil exploration and drilling. Then the crude must be transported … At the refinery, components of crude oil are broken apart and separated to make different organic compounds, including butadiene … Solvents used in these processes evaporate into the air during manufacturing, polluting the environment with VOCs (volatile organic compounds). *https://www.patagonia.com/pdf/en_US/neoprene_from_limestone.pdf*

xiii 'If modern facts have an incarnation, it is as rocks: hard, jagged, plain rocks – the kind you might hurl at a window or stub your toe against. They are the thugs of epistemology…The most valuable facts (for example, those of the scientific laboratory or the courtroom) are nothing like rocks. They are not lying around waiting to be found, nor are they clear and distinct objects with sharp outlines. Far from being obdurate, much less obstructionist, facts are often faint and flickering... Above all, as their etymology suggest (from the Latin *facere,* to do or to make, the same root as for *manufacture*), the most interesting and useful facts are not given but made, artifacts in the best sense of the word.' Lorraine Daston, *Hard Facts* (quoted Latour, Weibel (eds) 2005: 680-681).

xiv The term 'post-human' has been used in different ways, as evidenced here. More recent cultural discussions that address these issues have advanced other labels. See for example how the concept of a *Nonhuman Turn* removes any idea of a teleogical sense of progression from humanism to something that is beyond it (Grusin, 2015)

xv Bennet's project supports my enquiry, but the questions she asks of her collectives of strangely acting objects are different to my interests here. Much attention is give to the *results* of the connections; what is made through them, be it topsoil or history. This helps her to develop new ethical tools and insights. My project is different though. If materialities are forces and flows (Bennett, 2010: 117), can we understand anything about this flow? While this research shares many outlooks with that of Bennett's 'Thing-power', my desired outcome is to represent types of movement and change. It is artistic.

I am more interested in thinking about and showing something of the types of movement and style of actions that matter describes – in Deleuze's language, 'different dates and speeds... rates of flow... slowness and viscosity... acceleration and rupture' (Deleuze, Guattari, 1980: 3-4).

Bennett quotes Michel Serres to describe the articulated agency of objects (of nature, economy, biology or psychology) 'Conforming to a strange logic of vortices, spirals and eddies' (Bennett, 2010: 119, quoting Serres, 2001: 64). While I agree in some ways that forms of material change might be characterised as 'vortical logic' (ibid: 119), the type of knowledge and our way of operating a 'logic' that perceives or engages with this change is relevant. I start to ask which forms of understanding connect us with the types of change in question. Bennett herself cautions that language is in some way inadequate to the task of telling the full story of Thing-power

(ibid: 4). Visual art practices offer other ways of understanding and communicating connected change to lingustic logic.
In other passages of the same work, Bennett touches on other ways of knowing. She talks of the Chinese concept of Shi which signfies a 'style, eneregy or propensity' of a particular arrangement, rather than any particular element within it (ibid: 35). Found in social atmosphere of public spaces, or collective projects such as art or philosophy movements, this concept deals with a way of acting rather than a fact of or result from some kind of connection. She also describes De Landa's interest in a form of 'metallic vitality' found in the cracks of metal (ibid: 59). Here an emergent property is found within a structure's failure. The *life* of metal is found in its collapse, what Deleuze and Guattari might call its deterritorialization. This possibility of reading emergence and collapse through the actions of materials is close to the aims of this research. It also clarifies the relevance of the artwork I describe.

xvi This comment of scientific research as metaphor is interesting given this research's aim to use artistic methods to consider areas often dealt with by science.

xvii Interestingly, the number of these levels is part of the study of Panarchy. The more diverse a system (for instance an ecology), the greater the number of levels of different scale and this can vary. Whole levels of order can emerge with 'an alignment of the stars' (Holling, Gunderson and Peterson, 2002: 90) or be destroyed as during the earth's previous five mass extinctions, following which 'each took approximately 10 million years of evolutionary change to re-establish the lost diversity' (ibid: 90).

xviii White Noise contains 'many frequencies with equal intensities'. Oxford English Dictionary

xix This focus on the behaviour of things beyond human perception contrasts with systems of thought which start with the perceiving subject and then consider their relationship with the world (such as phenomenology).

xx Panarchy can be compared and contrasted helpfully with the work of Deleuze and Guattari. The theory of Panarchy describe processes in ecologies and other complex systems (such as bureaucracies and corporations) that display wave-like behaviour. Within or across a particular system (which we might describe as on a plane) intensity builds with an accumulation of resources. This can lead to greater fragility. Then collapse can occur. With that collapse resources (nutrient, capital...) is released and this collapse, although negative from the perspective of the previous set of circumstances, can lead to opportunities elsewhere (for instance in natural systems if we are mould or in economic ones if we are entrepreneurial). This is a 'double articulated' process of change involving emergence and collapse. The outcomes of the process may be seen as either positive or negative depending upon your position within the system. This process might be compared to aspects of deterritorialization and reterritorialization.
Furthermore, the immediate and simple process can move in another 'plane'. Rather than observing the activity within one ecological niche (and Gunderson and Holling describe the distribution of niches at increasing scale, from leaf to tree up to forest and ecosystem), we can look at change that moves between scales. At moments of fragility, collapse can cascade through different levels of scale. This is like a wave of change taking place upon a wave of change, or in Deleuze's terms absolute deterritorialization on the plane of immanence. The philosophy of Deleuze and Guattari helps understand or recognise connected changes in human and cultural and non-human complex systems. These can be understood as a series of interconnected waves, emerging and collapsing on many different scales.

 And while it has many similarities, the method of Panarchy also differs in important

ways from the ideas of Deleuze and Guattari. Deleuzian space encompasses human subjectivity. The work of Deleuze describes the shapes of thought, in ways that (according to De Landa, 2004) are found in other places too. Ecological theory adopts methods that have to cease at the boundary of human subjectivity. They must in particular remove any trace of the practitioner who produces them, otherwise they will be criticised as lacking objectivity. Despite sharing similar aesthetics, the two conceptual spaces of Deleuzian thought and Panarchy differ greatly in this critical respect. The lesson from this comparison is that much of the wave-like movement found in these two bodies of thought can help us articulate the thalassocentric. But I must modify the method from one based on Panarchy to one that is more Deleuzian in the sense that it includes its own process within its field of study.

xxi Other writers have used the insights of Deleuze and Guattari to understand and describe types of complex movements in the 'natural' or non-human world as types of time-based oscillations. Manuel De Landa describes the temporal dimension of complex systems, using the work of Deleuze, and focuses on the timing of such oscillations. He suggests a cyclic or oscillating figure that develops within and across different levels of order:

'Considered as a network in which the flesh (or biomass) of plants and animals circulate, an ecosystem will display a variety of temporal rhythms characterizing each of its alimentary couplings, these rhythms, in turn, associated with the spectrum of oscillatory behaviour at different scales exhibited by every organism' (De Landa, 2004:120). This scales up to larger orders to even include the evolutionary rate of species. De Landa is using Deleuze's theories to interpret temporal movements of expanding and contracting in ‘planes’ of organisation, that might be environment, population or species. And clearly human temporal cycles can be entangled with non-human ones. So we can expect to find cycles of oscillating figures penetrate societies and economics due to our multiple dependence on natural resource flows.

xxii Kant has distinguished between the world's empirical nature and its transcendental understanding (the 'empirical receptivity and transcendental constitution' of the world (preface in Meillassoux, 2009: 5)). This is a 'solution' which according to Badiou has 'broken the history of thought in two' (ibid: 4). The problem of showing how this is possible is the preoccupation of post-Kantian philosophy (Gutting, 2014). These types of philosophy have been called philosophies of access or correlationism (Meillassoux, 2009), as they centre on the problems of thought and the position of human knowledge. But 'Correlationists, in short, cannot think an object as it is in itself and correlationism assures the impossibility of ever thinking an object in itself' (Bell, 2006).

xxiii Hacking is the use and misuse of materials in novel ways. It owes much to Levi-Strauss's term of Bricolage (see xxiv).

xxiv Claude Levi-Strauss contrasts what he calls the 'bricoleur' with the engineer. While the engineer has a rational and planned relationship between task, available material and planned project aim, the bricoleur has to make do with available resources, which may not relate to 'The current project, or indeed to any project [.. but are...] the contingent result of all the occasions there have been to renew or enrich the stock or to maintain it with the remains of previous constructions or destructions' (Levi-Strauss, 1966: 17).

Deleuze and Guattari interpret Claude Levi-Strauss's idea of bricolage in their own intensive terms as 'The rule of continually producing production, of grafting producing onto the product, [it] is a characteristic of desiring-machines or of primary production: the production of production' (Deleuze, Guattari, 1984: 7).

The bricoleur has access to limited but diverse, even bizarre sets of materials, which can be continually rearranged in multiple combinations. These conditions result in loose and open attitude towards outcomes, instructions and the process of making. Misuse is clearly one of the bricoleur's cores skills.

xxv Open Source processes are those where the methods are shared so that others can repeat the activity or process. Open Source is common in collaboratively designed software – the Free and Open Source Software (FOSS) such as Linux, which offers a different operating system to proprietary software platforms such as Windows and Macintosh. Open Source design is also aspired to for reasons of sustainability in ways that owe much to Stewart Brand's Whole Earth Catalogue originating in 1968. The catalogue inspired a class of privileged 'New Communalists' to explore a style of environmental self-sufficiency, as long as they could afford the right tools (Turner: 45 in Diederichsen, Franke (Eds.) 2013).

xxvi This echoes and progresses the ideas of Brand's *Whole Earth Catalogue*, and other cultural narratives of independent escape from catastrophe. The BBC series *Survivors*, written at the time of energy anxiety due to oil supply is a good example from among many.

In the 1975 Television series Survivors, by Terry Nation, the implications of a massive collapse in population are explored. The origin of this collapse is explained only in the opening title sequence http://www.tv-ark.org.uk/mivana/mediaplayer.php?id=6cc0b3a6bde7ecb24b4ad34829cb9129&media=survivors1975&type=mp4
A laboratory accident, highly connected global travel and a population that is not resilient (here to an unexplained microbial threat) lead to the collapse of the industrial infrastructures that civilisations take for granted. The programme goes on to explore the implications and texture of this collapse in great detail over many series. Particularly interesting is how technologies are treated in these circumstances.

In the first episode of the first series, the characters Bronson and Abby discuss how to make light without relying on extensive industrial infrastructures.

'BRONSON: … What is important is learning again. Things you've never even needed to consider before. For instance, that! [points to candle]. Could you make that? Where does the raw material come from, do you know?
ABBY: Well, some sort of oil product, I suppose. Or before that tallow or animal fat.
BRONSON: But could you make it? Something as simple as a candle, starting from scratch.
ABBY: Well, I could probably find out. It must be in a book somewhere.
BRONSON: All right, take it from there. A book will tell you how electricity is generated. But could you do it, right from the very beginning? Find the metal in the earth, dig it up, refine it, turn it into wire? Could you make and cast glass for a light bulb? You'll need to know every part of every process. A carpenter, a man who works in wood. He doesn't chop down trees, he doesn't forge the steel for his saw. Could he make a hammer? Nails? For myself, I could perhaps, fashion some sort of stone tool.'

xxvii The Vimeo Website which hosted the ZDL explanation page described the process of the internet becoming unavailable due to malicious attack with the following messages:

“
######### UPDATE: February 1 at 1:33PM #########

The DdoS attacks are currently causing instability for the Vimeo on-site and embedded player. We're working as quickly as possible to restore stability. Thanks again for your patience.
######## UPDATE: February 1 ########
The DDoS are continuing, causing intermittent instability. Our developers are working hard to recover from the attacks and stabilize the site. Thanks for your support and patience, and apologies for the inconvenience.
######## Original Post: January 31 ########
Hi friends!
On Friday, Vimeo fell victim to a denial-of-service attack (en.wikipedia.org/wiki/Denial-of- service_attack) that caused the site to be unavailable to our members and visitors. This downtime affected only Vimeo.com – all embedded videos remain playable and working properly. Our entire team worked as quickly as possible to get things back up and running, and, as of right now, the site is online and stabilizing well. It's sitting upright and eating solid bits of data already!
You can rest assured that no user data was compromised, and NONE of your content (even all those weird videos you uploaded that one night) was lost or affected in any way. We sincerely apologize for the inconvenience this has caused. Things like this are a major bummer and not very fun to deal with. Thanks so much for bearing with us during this attack.
Love, Vimeo" http:vimeo.com/forums/help/topic:114011. [accessed February 5, 2014]

xxviii *Kayak Libre*, Manu Luksch & Mukul Patel, was a 'temporary experimental infrastructure' by Manu Luksch & Mukul Patel. Participants were invited to use a kayak as a water taxi to travel local canals. They paid for the 'services with conversation' (Luksch, Patel).

Ghost, Adam Chodzko, 2010 Alaskan yellow cedar, western red cedar, Fijian mahogany, oak, ash, olive, walnut, and mixed media.
The double kayak holds a paddler and a lying passenger, reclined as in a coffin. The journeys undertaken by the craft are to 'Islands of the dead' in an 'actual or metaphorical' sense. http://www.adamchodzko.com/

xxix 'As Falmouth celebrates its 350th birthday, men in suits behind desks seem to be planning to make sure it doesn't survive another ten.…You cannot imagine that anyone truly believes the area of grass, not even unique in the UK, is more important than the livelihood of thousands.' Falmouth Packet December 24 2010, Letters and Comment.
http://www.falmouthpacket.co.uk/lettersandcomment/skipper/9287960.Conservation_zone_could_be_the_death_of_Falmouth/ [accessed 14/11/2011]

xxx It has recently been discovered that Babylonian tablets may show details of construction for boats (Kennedy, 2014) Babylonian tablet shows how Noah's ark could have been constructed (guardian.com)
http://www.theguardian.com/culture/2014/jan/24/babylonian-tablet-noah-ark-constructed-british-museum

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